

SOUTHERN TIBET

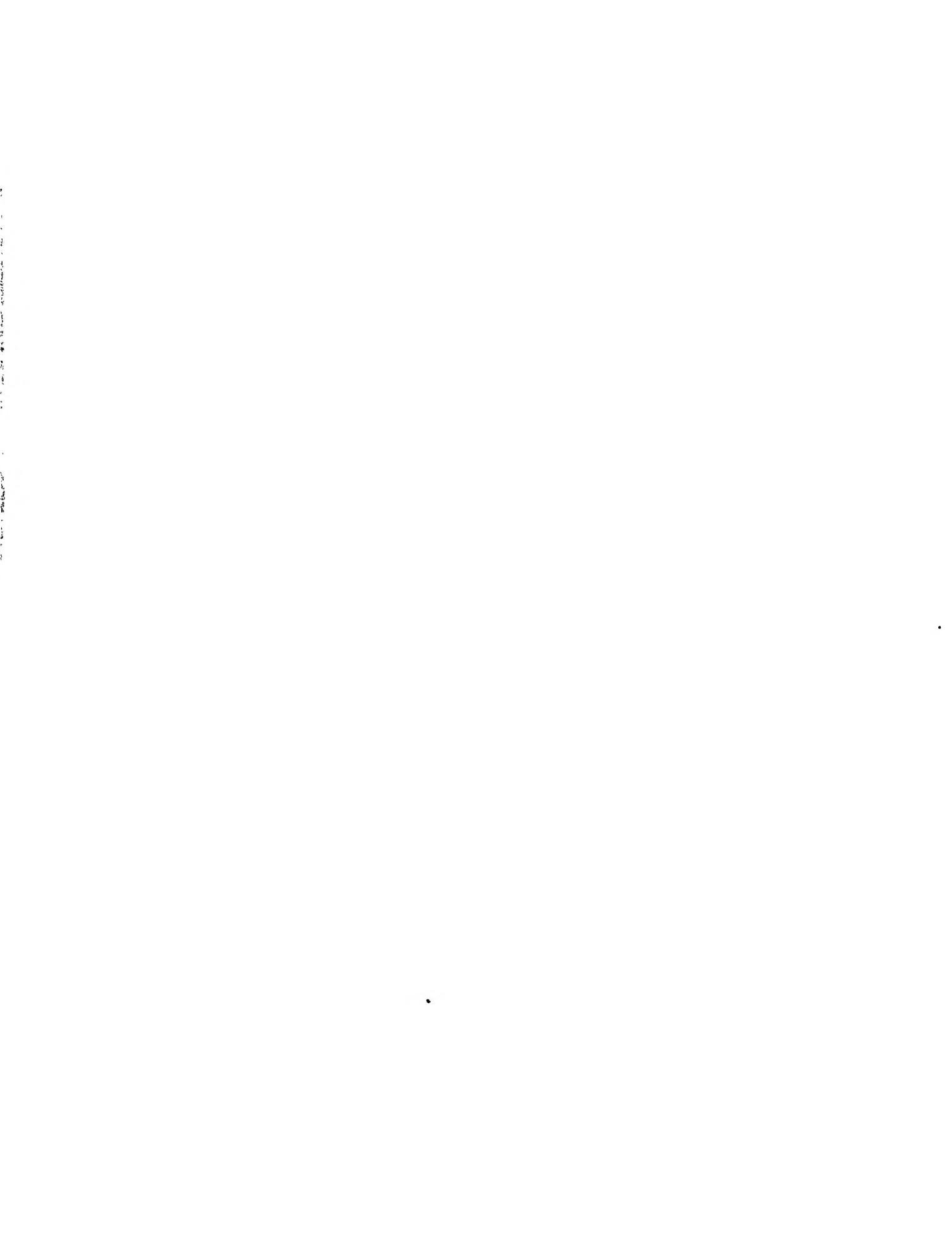
BY SVEN HEDIN



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SOUTHERN TIBET

1906—1908



DISCOVERIES IN FORMER TIMES COMPARED
WITH MY OWN RESEARCHES IN 1906—1908

BY

VOL. II

LAKE MANASAROVAR AND THE SOURCES OF THE GREAT
INDIAN RIVERS. — FROM THE END OF THE
EIGHTEENTH CENTURY TO 1913

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MODERN EXPLORATION
IN SOUTHERN TIBET

CHAPTER I.

MAJOR RENNELL'S MAP, 1782.

On Major RENNELL's famous and beautiful map of India,¹ which was published both in the French and German editions of Bernoulli's work, southern Tibet is also entered.

The Indus or Sinde River is supposed to rise from the mountains situated west of Kashgar (Cashgur), and the Satlej, as a comparatively small river, to start from the southern side of the Himalayas. The real upper Indus, passing Latac, is turned down to the Ganges and the real upper Satlej likewise. This is an artificial 'capture' of river-courses that looks very strange on the map: the Ganges has captured the upper courses of the Indus and the Satlej. The great Surveyor General in Bengal had really no other sources to consult than the survey of Emperor Kang Hi's Lamas, carried out some 70 years earlier. We have seen that the Lamas never went westwards from the lakes, so the whole of this part of Rennell's map had to be built up on the hypotheses of people who had never been to the country in question.

It is not easy to find out what Rennell really believed in this matter. In his text he describes the Indus as formed of some ten principal streams descending from the Persian and Tartarian mountains on the N.E. and N.W. The *Ain-i-Akbari* places the source at Cashgur and Cashmere, from which it appears that the natives consider the N.E. branch as the main river. Looking at the map one would think he had great confidence in the Lamas' representation of the sources of the Ganges, for these river-courses are drawn in unbroken lines, whereas the Tsangpo-Brahma-putra, which is correctly represented, is drawn with a dotted line. But on the other hand he says in his text:² 'In placing the heads of the Ganges and Sanpoo rivers, I have followed M. D'Anville's correction of the Lamas' map in Du Halde, as given in his first part of the map of Asia, published in 1751: and have continued the

¹ Hindoostan. By J. RENNELL, F. R. S. 1782. Copied at Berlin by BENJ. GLASBACH, 1785.

² Memoir of a map of Hindoostan etc. Second Edition, London 1785, p. 55. and 104.

course of the Ganges to the place where it enters Hindoostan, from the same map. I . . . consider this part of the Lamas' map as a very vague performance; but the want of better materials obliges me to make use of it. I suspect that the Ganges does not take quite so wide a circuit to the north-west, as is there described.»

Thus Rennell seems not to have doubted the general correctness of the Lamas' map, but suspected that the western bend of the source-branches went too far west. For he says of the Ganges and Brahmaputra: »A circumstance attending the courses of these rivers, in respect to each other, is remarkably singular. Issuing from opposite sides of the same ridge of mountains, they direct their courses towards opposite quarters till they are more than 1,200 miles asunder; and afterwards meet in one point near the sea, after each has performed a winding course of more than 2,000 miles. Our ignorance of this circumstance, till so very lately, is a strong presumptive proof, that there yet remains a vast field for improvement, in the Geography of the eastern part of Asia.»

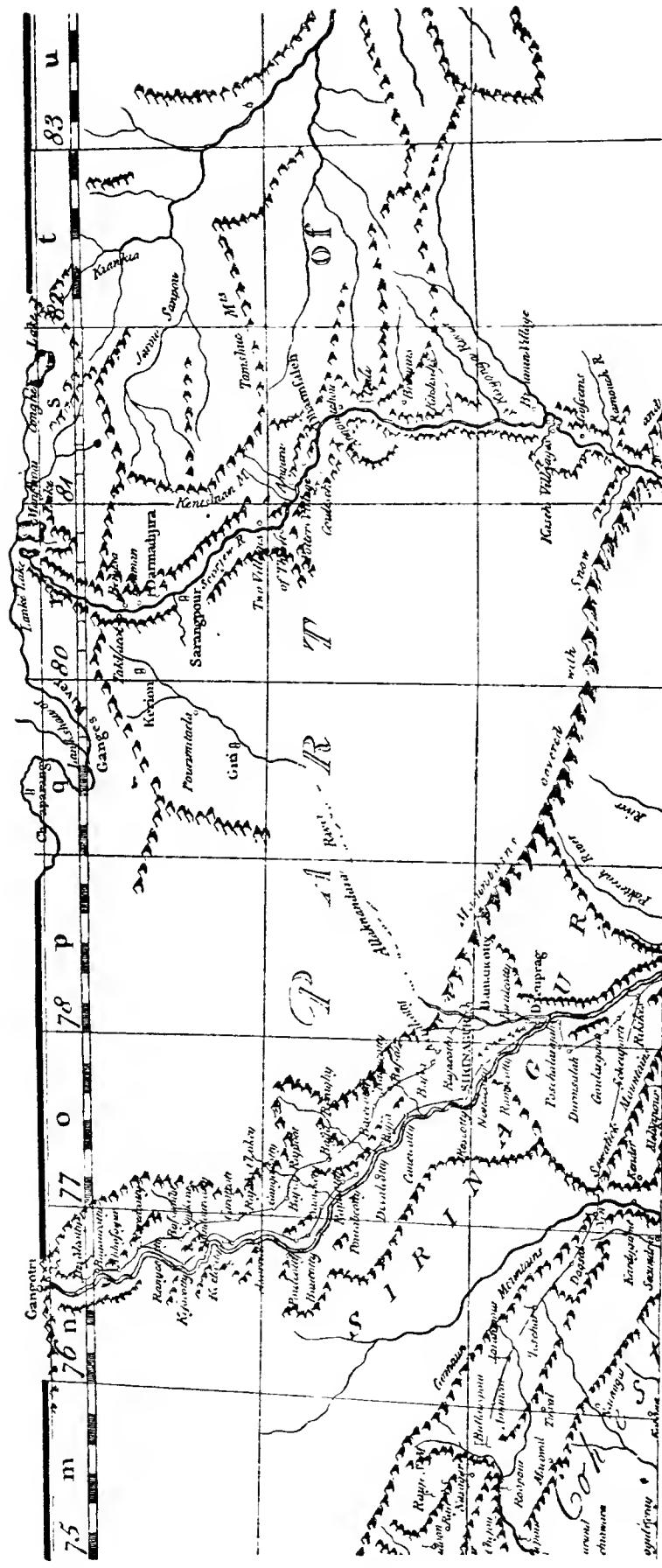
Further on, in a chapter called *An Account of the Ganges and Burramputer Rivers*, he does not seem to doubt the general correctness of the Lamas' map, for he says:¹ They are now well known to derive their sources from the vast mountains of Thibet, from whence they proceed in opposite directions; the Ganges seeking the plains of Hindoostan by the west; and the Burramputer by the east.» And still farther on he says again:² »The Burramputer, which has its source from the opposite side of the same mountains that give rise to the Ganges, first takes its course eastward (or directly opposite to that of the Ganges) through the country of Thibet, where it is named Sanpoo or Zanciu, which bears the same interpretation as the Ganga of Hindoostan: namely The River. The course of it through Thibet, as given by Father Du Halde, and formed into a map by Mr. D'Anville, though sufficiently exact for the purposes of general geography, is not particular enough to ascertain the precise length of its course.»

ANQUETIL DU PERRON has some objections to make to Rennell's views on this question.³ When Rennell regards the map of the Lamas, so far as the Ganges is concerned, as rather vague, Anquetil du Perron remarks that *he*, already in 1776 in *Journal des Savans* had proved and printed that the Lamas' work was erroneous, and when Rennell says he had to use the material existing as nothing better was available, Anquetil thinks it was wrong to use material which was known to be false. When Rennell speaks of the Ganges and the Tsangpo as beginning from the same mountain, he is wrong, says Anquetil, for it is the Gagra and the Tsangpo that begin from the same mountain. Now we know that both alike were wrong. When Anquetil du Perron used TIEFFENTHALER's authority and Rennell that of the Lama map, Rennell got by far the best of it. He ought to have quoted Anquetil's

¹ Op. cit. p. 138.

² Op. cit. p. 158.

³ BERNOUILLI, op. cit. II, p. 491.



The Lakes and the Sources of the Sutlej and Ganges on Rennell's map of 1788.

results, which were not unknown to him, as he quotes him in connection with other questions. In spite of this controversy Anquetil du Perron expresses the highest admiration for Rennell's work.

On Rennell's map we recognise the same bends of the rivers as on d'ANVILLE'S Lama map, and we find Chaparang and Choumortsy on the same place. The outlines of the lakes and the mountains are not quite the same, although it is not said why the changes have been made. No names have been given to the lakes and the distance between them is much greater than on d'Anville's map, which is by far the better of the two.

A meridional range separates the basin of the *Ganges* from that of the Brahmaputra, and the northern part of this range is called Mount Kentaisse.

The uppermost part of the Brahmaputra is also a little changed from d'Anville's map, and by some curious luck, really a little improved. Thus we may identify, with some good will, the southern branch with the Kubi-tsangpo, the middle one with the Chema-yundung and the northern one with the Maryum-chu, although the resemblance with the reality is only vague. On Rennell's map the Maryum-chu goes through a lake which may be supposed to be the Gunchu-tso, although this lake is drawn much better on the Lama map, where it has got its real name and is correctly placed on the western, and not on the eastern side of the water-parting.

The Lamas have the correct name Tamtchou Mts at the source of the southern (Kubi) branch of the Tsangpo, whereas Rennell writes the legend: "*Heads of the Ganges and Burrampooter (or Sanpoo) Rivers*", just south and S.E. of the Manasarovar. He has also spoilt the small rivers entering the lake, which are admirably drawn on the Lama map. But the most important characteristics are these: a channel between the two lakes and a river, supposed to be the Ganges, leaving the Rakas-tal, and so far the results of the Lamas' work are saved on Rennell's map.

Only the mountains at the southern side of the Tsangpo are put in. The road, which he believed was travelled by GEORGI, although this Father had never been in Tibet, is marked from station to station. Chamnamrim of the Lama map has become Chanmanning, which is not an improvement on the real Shang Namling. Most other names are as easy to recognise as on the Lama map. The greatest merit of the map, so far as Tibet is concerned, is, however, that Rennell understood that the Brahmaputra must be the lower course of the Tsangpo. From this point of view the Tibetan part of his map is a historical document of eminent value and importance.

I reproduce here on Pl. I the region round the lakes, as it is represented on a later edition of Rennell's map.¹ The source of the Satlej is placed a little

¹ Its full title is: A Map of Hindoostan, or the Mogul Empire: From the latest authorities. London, 1st January 1788. J. RENNELL.

to the north of Belaspoor in the »Gomaun Mountains». As to the lakes and their functions Rennell tries to reconcile Anquetil du Perron's criticism with the map of the Lamas, and gets a *mixtum compositum* of both. He accepts Anquetil's Sardjou (Gagra), his own Soorjew R. issuing from the Lanké Lake or Rakas-tal. Of the river which leaves the Manasarovar to the N.W. Anquetil had the legend: »It is said that the Satloudj, which goes to Belaspour and Ludiana, issues from this lake, but this assertion is not at all worthy of being believed, as it is more probable that it joins the Alaknanda, which irrigates Badrinath and Srinagar, or some other river.» On his map of 1788 Rennell takes d'Anville's Lanctchou R., which comes from L. Lanken, and makes it start from the north-western corner of the Manasarovar instead. And at the same time he changes the name of the river from Lanctchou to Ganges River. But he does not let it join the Alaknanda, as Anquetil proposes; one is really left in some uncertainty about its goal. For just here the map is cut off, and the real Ganges has its source at Gangotri, at the southern side of the mountain range.

It is indeed curious to follow these peregrinations of the upper Satlej! The Lamas and d'Anville correctly make it issue from the Rakas-tal, but call it Ganges. Tieffenthaler has got the information that the Satlej issues from the Manasarovar. Anquetil does not believe this information, and makes the river a tributary to the Alaknanda »or some other river». Rennell does not believe in its junction with the Alaknanda, but calls it simply Ganges. Therefore he believes, as do the Lamas also, that »Chaparang» is situated on the Ganges. And still, 160 years earlier, Andrade had seen the source of the Ganges on the Mana pass, at the northern side of which the water was flowing to Tibet. If Andrade or anybody else amongst the Jesuits, who lived for many years in Tsaparang, only once had stated that this city was situated on the Satudra or Satlej, they would have spared geographers two centuries of trouble concerning the source of the Ganges.

Rennell's map of 1788 is far from being an improvement on the Lama map. The same can be said of his representation of the Gunchu-tso. On the Lama map this lake has no superficial connection with the Manasarovar, but on Rennell's map a river joins it with the Manasarovar, a river which thus could be regarded as the source of the Ganges. The brook which is the real source of the Satlej, and which, on the Lama map, joins the Soma-tsangpo at its mouth in the Manasarovar, has been removed far to the east on Rennell's map. The source branches of the Tsangpo, »Kiankia», »Jarou Sanpou», and the branch from the »Tamshuc Mts» have not been altered from the Lama map, and are therefore much better than the rest.

CHAPTER II.

SOME CONTEMPORARIES OF MAJOR RENNELL.

In comparison with his predecessors, SANSON and DELISLE, d'Anville marks a very considerable step forwards in the knowledge of the geography of our regions. He got his materials from the Jesuits in China, and all he had to do with their detailed maps was to prepare them for engraving. As to the general map of Tibet he drew it from the detailed sheets, arranged it in accordance with known astronomical points, and entered all information he could gather from other sources than those of the Jesuits.¹

Major Rennell's work was equally important to the geography of India. In one respect he had much greater merit than d'Anville, namely, in relying upon his own personal observation in the solution of several important problems. Amongst other things he traced, in 1765, the course of the Brahmaputra for about 400 miles above the conflux with the Ganges, and therefore arrived at the conviction that the Brahmaputra was the continuation of the Tsangpo. For regions which he had not seen himself he had to accept the Lamas' map, which he does not find »altogether favorable to its character, especially in the parts towards the source of the Sanpoo and Ganges«. Therefore he gladly followed the advice of Anquetil du Perron and changed the hydrography in accordance with Father Tieffenthaler.

SPRENGEL is no doubt partly right in saying that ORME, Rennell and Tieffenthaler augmented the knowledge of India to such a degree that from 1770 to 1790 more light was spread over the country than before, ever since the discoveries of the Portuguese.² Of these three names Rennell's is by far the greatest. Orme's geography of the northern borderland of India is nothing else than a translation into words from d'Anville's map.³ He was a historian and not a geographer. To him Mount Caucasus still separates India to the north from different Tartarian nations and from Great and Little Tibet.

¹ Notice des ouvrages de M. d'ANVILLE, Paris 1802, p. 84.

² Geschichte der wichtigsten geographischen Entdeckungen bis zur Ankunft der Portugiesen in Japan 1542, von M. CH. SPRENGEL, Halle, 1792, p. 31.

³ ROBERT ORME: Histoire des Guerres de l'Inde, ou des événemens militaires arrivés dans l'Indoustan depuis l'année 1745. Translated by TARGE. Amsterdam 1765, p. 2 and 25.

As a rule it took some time before the discoveries and the new maps were generally accepted in Europe. Amongst geographers, and in geographical handbooks the important innovations of d'Anville and Rennell could, of course, not be ignored. Other writers still went their own ways. A few examples will show how far the great cartographers of the time had made an impression upon their contemporaries.

In his geography of 1794, BORHECK places the source of the Ganges on the west side of Mount Kantaisse, after which the river flows in three arms westwards, and finally south-eastwards to India. This is d'Anville's and Rennell's view. The Tsanpu or Burremputer has its sources on the S.E. side of Kantaisse. Here he does not follow d'Anville's map and is therefore wrong.¹

SONNERAT only regards the geography from a mythological point of view.² He quotes BAILLY in pointing to Mount Meru, the dwelling-place of the penitents, or generally Tibet, as the region from where the inhabitants of India originally came down to the plains.

An article: *Mémoire sur le Thibet, et sur le Royaume des Eleuthes . . .* in *Lettres Édifiantes*, contains an antiquated standpoint, without any new additions.³ Tsang is said to be the ordinary Chinese name for Tibet. It is also called Sy-Tsang, Parountola, Barantola, Toufan, or Tangout. Then the old legend of Christians in Tibet is explained. Since the last years of Kang Hi's reign, Chinese Emperors have always had Ganges-water in their palace and on their journeys.

In his work on Neareus' journey WILLIAM VINCENT has a few words about the sources of the Satlej and Indus.⁴ He identifies the Setlej or Setledge of Rennell with the Saranga or Saranges of Arrian, the Hesudrus of Pliny, the Zadadrus, Zaradrus or Zardrus of Ptolemy, the Shatooder or Shetooder of the Sanscrit and of *Ain-i-Akbari*, the Satludj, Setooge and Satluz of Tieffenthaler, and the Seteluj of Persian and Hindustani. The source of the river is situated far away to the N.E., in the mountains of Ghaloor. The sources of all the rivers, forming the Indus, are situated on the southern side of the long range called Hindoo Khoo, which separates Tartary from Hindustan. Only the Indus itself according to Rennell, pierces the range just as the Ganges and Burhampooter; but the real source of the Indus is unknown. The mountains which border Kashmir on the east seem to divide into two ranges, called Tchamou by Sherefeddin, and Jemmoo by modern geographers. Between these two ranges Timur marched on his retreat from Delhi, and Vincent thinks that the sources of the Satlej are most likely situated there.

The river Lanctchou on the Lamas' map, which was in reality the Satlej, had been identified by them with the main branch of the Ganges, and Rennell followed

¹ Erdbeschreibung von Asien, Dusseldorf, 1794, Bd. III, p. 637.

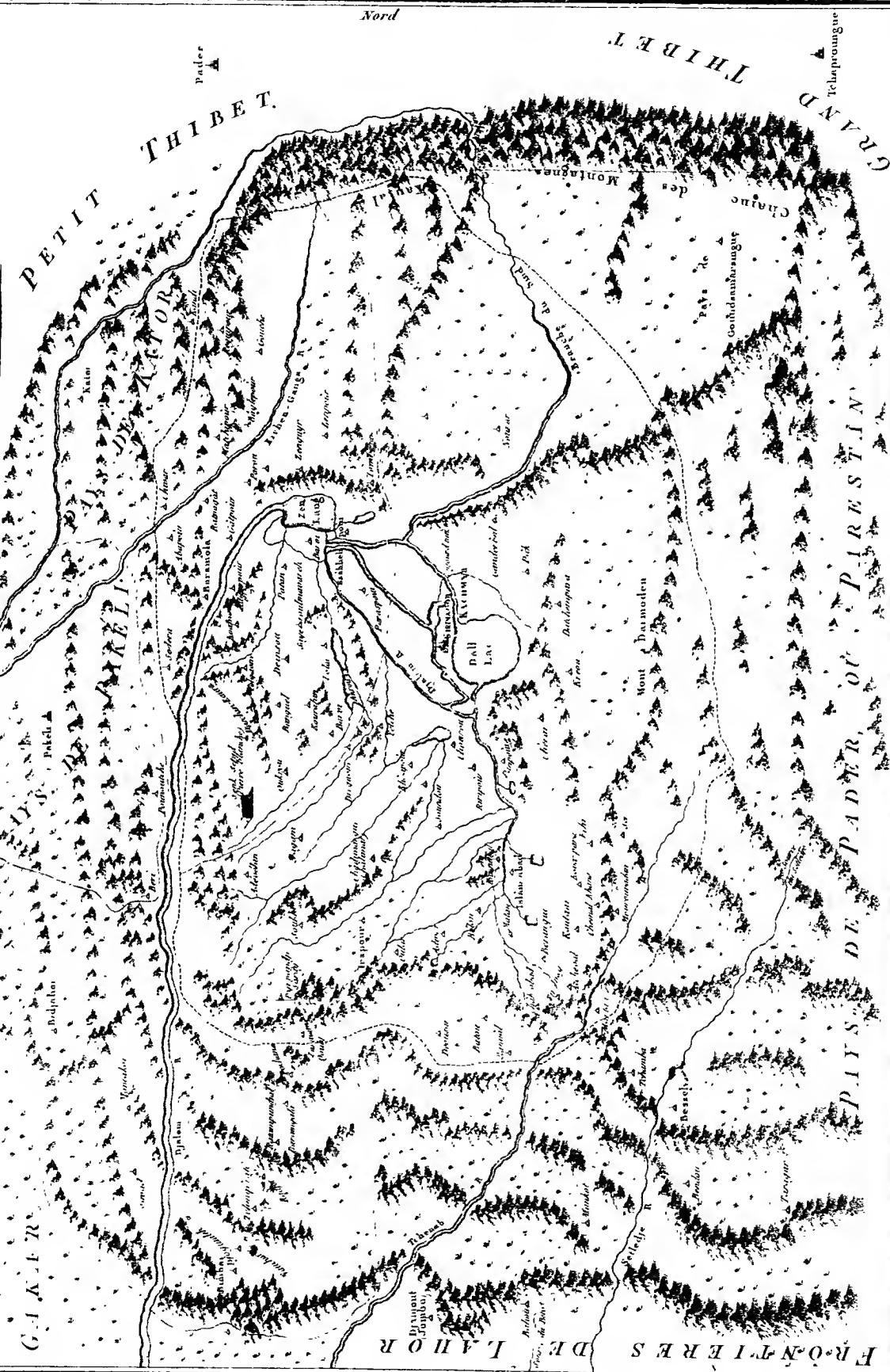
² Voyage aux Indes Orientales et à la Chine, 1774—1781. Par M. SONNERAT. Paris 1782, Tome I, p. 273.

³ XXXI Recueil, Paris, 1774, p. 212 et seq.

⁴ I have at my disposal the French edition of J. B. BILLECOQ: Voyage de Néarque des bouches de l'Indus jusqu'à l'Euphrate, etc. Paris, An VIII, p. 101 et seq.

CARTE DU PAYS DE KACHIN

Carte Description de l'Hindoustan, manuscrite,
déposée à la Bibliothèque Nationale,
par le Cap^t GENTIL.



Map of Kashmir by Capt. Gentil.

their example. Therefore the source of the Satlej had to be searched for elsewhere, and Vincent found it probable that it must be situated in the ranges which were supposed to be a continuation of the mountains on the eastern border of Kashmir. The upper Indus of the Lama map was also believed to be a source branch of the Ganges, and therefore, naturally enough, the upper Indus was regarded as altogether missing on the Lama map, as published by d'Anville, and Vincent, of course, had nothing else to say than that the ultimate source of the Indus always remained unknown. On Vincent's map, which was published in London in 1797, none of the Panjab rivers come from western Tibet.

On the general map of GEORGE FORSTER's journey, 1783—84, the Satlej has its source not very far above Belaspoor, and the Indus comes down to Attock from the N.N.E. Farther east we have the Ganges, formed, as on d'Anville's map, by the real upper Indus and upper Satlej.

The map of Kashmir in the second volume of Forster's work¹ is indeed interesting. Its title is: *Carte du Pays de Kashmyr tirée d'une Description de l'Hindoustan, manuscrite, déposée à la Bibliothèque Nationale, par feu le Cap^e Gentil*, and it contains both the source of the Indus and of the Satlej (Pl. II). To the N.W. of Srinagar is Petit Thibet and to the N.E. Grand Thibet with Andrade's city, Tchaproungue. Kashmir is separated from the two Tibets by a very high range of mountains, called Chaîne des Montagnes du Kantal, in which we recognize Desideri's Kantal, or Zoji-la above Baltal. At any rate, the range of Kantal represents a water-parting of the greatest importance, for on it we find a lake, due north of Srinagar, which is the origin of a branch of the Sind, obviously the Sind of Sonamarg, flowing south, and the great Sind, flowing north, but immediately turning to the west and south. On the lake is written: 'Source du Sind'. Thus the source of the Indus is given as only twice as far from Srinagar as Baramola. And that it is really the great Indus itself appears from the fact that it flows direct to Attock. Unfortunately the Kishen Ganga joins it above Attock.

Not less curious is the representation of Satlej, which is smaller and shorter than its neighbour the Chenab. The legend: *Source du Setledje* is placed S.E. of Srinagar at about twice the distance to Baramola. It is quite natural that the river here does not come from a lake, for the Manasarovar and Rakas-tal were, since the survey of the Lamas, occupied by the Ganges.

On the north and N.E. Kashmir is, according to Forster, bordered by the mountains of Tibet.² He regards them as a branch of the immense range which begins at the Black Sea, runs through Armenia and along the south coast of the Caspian Sea and stretches through the provinces N.E. of Persia all the way to Tibet and China.

¹ Voyage du Bengale à Petersbourg, etc. Transl. by L. LANGLES. Paris 1802. LANGLES has added some notes, which, for our regions, are without any importance.

² Op. cit. Tome I. p. 295.

CHAPTER III.

AN ACCOUNT OF TWO FAKIRS.

In the *Asiatic Researches*¹ I find an article under the title «*An Account of Two Fakirs*» by Jonathan Duncan, Esq., in which the sacred lake is mentioned.

One of the Fakirs was a certain PURANA POORI, then at Benares, with his arms and his hands in a fixed position above his head. He was a very intelligent man, who had been a great traveller, and, in May 1792, he gave a relation about his observations in the various countries which he had visited. Duncan gives only the principal part of his story, and has the utmost reliance on our traveller's not designing to impose in any part of his narrative; but allowance must be made for defects of memory . . .

We are not concerned with the beginning of his adventures. Let it suffice to say that he came to Balkh, Bokhara, Samarkand, Badakshan, Kashmir; and from that passing over the hills towards Hindustan, he came to the Gungowtri, or 'Decent of the Ganges', where there is, he observes, a statue of Baghiratha; at which place the river may, he says, be leaped over . . . Then he proceeded to Katmandu and into Tibet, and *via* Tingri to Lahassa, and the mountain of Patala, the seat of the Delai Lama, whence he proceeded to Degurcha,² which he mentions as that of the Taishoo Lama: and then, in a journey of upwards of eighty days, reached the lake of Maun Surwur, (called in the Hindu books Mánasaróvara;) and his description of it I shall here insert in a literal translation of his own words :

'Its circumference is of six days journey, and around it are 20 or 25 Goumaris, or 'religious stations or temples' . . . The Maun Surwur is one lake: but in the middle of it there arises, as it were, a partition wall; and the northern part is called Maun Surwur, and the southern Lunkadh, or Lunkdeh. From the Maun Surwur part issues one river, and from the Lunkadh part two rivers: The first is called Bráhma, where Puresram making Tupisya, the Bráhmaputra issued out, and took its course to the eastward; and of the two streams that issue from the Lunkadh, one is called the Surju, being the same which flows by Ayóddyà, or Oude; and the other is called Sutroodra. (or, in the Puráñas, Shutudru, and vulgarly the Sutluje,)'

¹ Vol. V 1807, p. 37 et seq.

² I. e. Shigatse.

which flows into the Punjab country; and two days' journey west from the Maun Surwur is the large town of Teree Ládak . . . Proceeding from Ládak, seven days' journey to the southward, there is a mountain called Cailasa Cungri, which is exceedingly lofty; and on its summit there is a Bhowjputr tree, from the root of which sprouts or gushes a small stream, which the people say is the source of the Ganges, and that it comes from Vaicont'ha, or heaven, as is also related in the Puráñas; . . . At four days' journey from Cailasa Cungri is a mountain called Bráhmadanda, or Brahma's staff, in which is the source of the Aliknundra Ganga . . .

This description really betrays several defects of the memory of the holy Fakir. He has quite forgotten the situation of Kailas Gangri, and he has not been able to get the Ganges to rise from any of the two lakes. But he has heard the people say that the source of the Ganges is situated on the Kailas. He has nothing to say of any channel between the two lakes. When he says it is *one* lake, one feels inclined to think of a communication, but when he talks of a partition wall one thinks of two different lakes. He positively asserts that the Satlej comes out from Langak-tso and he makes the Brahmaputra begin from the Manasarovar. The fact that he makes one river flow to the east from the eastern lake, and the two other rivers to the west from the western lake seems to indicate that he regards the »partition wall as a definite water-parting. Add to this that, although he went round the Manasarovar and visited the temples, he does not mention any channel. From all this one gets the impression that there was no water in the channel at the time of his journey which has obviously taken place several years before 1792, say 1770 or 1780.

It is not easy to draw any reliable conclusions from such a meagre and fantastic report as this and it would not be worth while to attempt the task, if it were not for using every possible hint in clearing up the periodical fluctuations in the hydrography of a country very little known. To a certain extent the Fakir's view is so like Tieffenthaler's map, that both seem to come from the same source. In both cases there is no talk of any channel; the Brahmaputra begins from the Manasarovar and the Sardjou or Surju begins from Rakas-tal. The names of the lakes are the same, although written in different ways, Manasaroar and Maun Surwur, Lanka Dhé and Lunkadh or Lunkdeh. The only difference is that on Tieffenthaler's map the Satlej goes out of the Manasarovar, whereas the Fakir makes it begin from Rakas-tal. The Fakir also makes the Ganges start from Kailas, but here he relies upon what people and Puráñas say and does not tell where and how the river passes the lakes, unless he means that it goes to Rakas-tal and reappears in the Surju.

As he is wrong in everything he says about the Ganges, the Brahmaputra and the Surju, his statement of the Sutroodra, which happens to be correct, is not worth very much. But strengthened by the information given to Tieffenthaler, it points, although vaguely, to the fact that the Satlej really went out of the Rakas-tal in those days. And if this view be accepted, the channel between the lakes must, of physical necessity, also have been full of water, as the Satlej could not be fed from any other source.

The other Fakir, who was questioned by Duncan in August 1792, had travelled between Nepal and Kashmir and had also visited Maun Talaee, as far as which (the country) is inhabited, but not beyond it. He has nothing else of interest to tell, except that at the Maun Talaee the boundaries of four countries meet, viz. that of China, of the Lama's country, of the Besher country, and of the Cooloo country.

It is a pity that not many descriptions of the same kind as the first Fakir's narrative should have been preserved to our time, to enable us to follow the hydrographical fluctuations and the periodical outflow of water from both lakes.

CHAPTER IV.

WILFORD'S COMMENTS ON THE LAKES AND RIVERS OF SOUTH-WESTERN TIBET.

Klaproth had no high opinion of Captain F. WILFORD and he was no doubt right in saying that some of his deductions and theories were somewhat audacious. In his long article on *The Sacred Isles in the West*¹ there is, however, to be found a great amount of valuable information about the two lakes and the rivers supposed to rise from them, and as Wilford has taken great trouble to gather all material existing at his time, or at the beginning of 1800. I think it necessary to quote the more important passages of his article.

Of the Manasarovar he says:²

»From Mána-Sarovara or, according to the vulgar pronunciation, Mánsaraur, the lake of Mána or Mánasa, issues the Ganges. According to Pura'n-gir, who accompanied the late Lama to China, and had seen that lake in his way from Lassa to Ládac, it is called in Tibet, Chu-Mápanh, or the lake of Mápanh. In the Lamas' map it is called Mapama: but Pura'n-gir, a well informed man, assured me that its true name was Mápanh. It was probably written at first Mapam by Portuguese Jesuits, in whose language the letter M, at the end of a word, has a nasal sound, as it had in Latin, and is to be sounded like the letter N at the end of a word in French.«

After having tried to elucidate the confusion in the *Purāṇas* about Bindu-Sarovara and Mána-Sarovara, Wilford continues:

»According to Pura'n-gir, this lake (Mápanh) is situated on an elevated plain covered with long grass, to the north of which is a conical hill called Khyem-lung, and dedicated to Mahá-deva; and which is inserted in the map of the Lamas, but without name, and with two roads ending there. It is one of the southern peaks of mount Cantaisch,³ which rises above the rest to an amazing height. A small stream, rising behind the subordinate peak of Khyem-lung, is considered by pilgrims as the source of the Ganges. There ended the survey of the Lama mathematicians; and the countries to the South, and South-West, were added afterwards, from

¹ An Essay on the Sacred Isles in the West, with other Essays connected with that work. By Captain F. WILFORD. Asiatic Researches, VIII. 1808, pp. 245 et seq.

² Op. cit. p. 327 et seq.

³ Kentais-e, Kailas.

the report of natives.¹ During the rains the lake is said to overflow, and several streams rush down from the hills: but they soon dry up, even the sacred stream itself not excepted.²

PURANGIR was a pilgrim from Hindustan and a Gosein or a Brahmin religious, who had been used several times by WARREN HASTINGS as an interpreter and spy in Bhutan and Tibet.³ He had accompanied the first deputation from Tibet to Bengal, in 1773.⁴ He had accompanied BOGLE in 1774—75 and TURNER in 1783. Between those two missions he had travelled with the famous Tashi Lama to Peking in 1779, a journey of which he has given a description.⁵ He seems to have been a very reliable and trustworthy man. Therefore, the description he gives of the Manasarovar is probably by far more conscientious and reliable than any other narrative of a pilgrim from Hindustan. I am not aware of the date of his journey, but as he was very much occupied in political work after 1773, it seems probable that his journey to the Manasarovar took place some time before that date.

Purangir was told that the lake used to overflow during the rains, that is to say, that the channel carried water in the rainy season; but in the dry season it seemed to be dry. There is a yearly period of rise and fall in the level of the lake, independent of the longer one during which the channel is dry even in the wet season.

From his description it seems as if Purangir believed the Ganges was rising from near the Kailas, entering the Manasarovar and then issuing from the lake. Thus he regarded the lake as an intermediate stage in the course of the river below its source. We have, as usual, only to substitute Sotlej for Ganges to get the right hydrographical situation.

Wilford continues:⁶

»According to Pura'n-gir, and other pilgrims from India, this extensive plain is surrounded on all sides by peaks, or conical hills, but very irregular: toward the North they rise gradually, and a little beyond the sugar-loaf hill of Khyem-lung begins the base of Cantaisch. Toward the East the range of peaks is very low, forming only a serrated crest. To the South this crest is much higher than toward the other cardinal points: but, to the North, the mountains beyond the crest are very high. The Southern crest is very near the banks of the lake. The lake itself forms an irregular oval, approaching to a circle, but the two inlets or smaller lakes to the north are said not to exist, for Pura'n-gir's route was to the north of the lake, and close to its shore, and he did not see them. Pilgrims are five days in going round the lake, and the place of worship, or Gombah, is to the south. It consists of a few huts, with irregular steps down the banks of the lake. The Ganges issues from it, and during the dry season its stream is hardly five or six inches deep. It does not go through the lake called Lanken in the maps; it flows to the south-east of it, at the distance of two or three coss. This lake is

¹ Compare above Vol. I. p. 266.

² KÖPPEN, op. cit. p. 218.

³ TURNER: An Account of an Embassy to the Court of the Teshoo Lama in Tibet, London 1800, p. VI.

⁴ TURNER, op. cit. p. 457.

⁵ L. c. p. 328.

called in India the pool of Ra'vana: and because he is the Lord of Lanca, his pool is called the lake of Lanca, or Lanken, in the maps.¹

This passage contains some geographical features of great interest. The very condensed orography is good. At least it seems as if he had observed that the Kailas and its eastern continuation was not the head-range, when he says that to the north, beyond the crest, the mountains are very high. He has also observed that the crest which rises from the southern shore of the lake, i. e. the Gurla-inandata, is much higher than any other mountain in the vicinity.

The form between irregular oval and circle, which he gives to the lake, is perfectly correct. The two small lakes on the northern shore are, of course, the same as on d'Anville's map. Purangir could easily have passed without seeing them. If one goes quite close to the bank, the beach which accompanies it will hide the two small lakes. In 1907 and 1908 only one of them was filled with water and on the place of the other the ground was swampy. But the one existing was much smaller than on d'Anville's map, showing that the precipitation was much smaller in 1908 than 200 years before. For it is obvious, that during a particularly wet period, when the channel carries issuing water, the lagoons on the northern shore must be bigger than in a period when there is no water in the channel, as in 1907 and 1908.

Five days for a man going on foot round the lake will perhaps be the ordinary rate, though it is slow, making only 9 miles a day; but then, perhaps, they spend some part of the time in the *gompas*. The Gombah or place of worship is Tugu-gompa on the southern shore. There may easily have been some irregular steps down to the lake 140 years ago.

The Ganges (i. e. the Satlej) is positively said to issue from the Manasarovar in the year 1770 or thereabouts and the channel is said to carry water even in the dry season. It is more difficult to understand how he could make the channel turn round to the S.E. of Langak-tso, instead of emptying its waters into that lake. It is chiefly owing to the fact, that pilgrims who came to worship the Manasarovar did not care in the least for the western lake. As it is specially pointed out that the issuing stream does not go through Langak-tso, Wilford herewith probably wishes show that the Lama map was wrong on that point. But it is curious how he could accept that interpretation, remembering the statement that the highest mountains rise directly from the southern shore of the lake. The misunderstanding is the more extraordinary as Wilford believed that the river issuing from Langak-tso really was the Ganges and not the Satlej.

To the West of this lake springs the Sita-Cant'há, probably the Sitocatis of Arrian. It is called also the Mlech'há Gangá, or impure Ganges: and is supposed, by some, to be the same with the Satlaj or Sitlodá in the Panjáb: this erroneous idea seems to originate from its being called by pilgrims Sitlodá, but its true name is Sitodá, nearly synonymous with Sita-cánt'há. The famous Jaya-sinha, Rajah of Jaypoor, sent people as far as the Cow's mouth, and they found that the Sitoda, after flowing for a considerable space toward the West suddenly

turned to the South, came within two miles of the Cow's mouth, and fell into the Ganges about sixteen coss lower.»

The Sita-cánt'há is the Satlej but probably not the Sitocatis of Arrian. Stating that it springs to the west of the Manasarovar the author makes it clear that no other branch than the Langchen-kamba can be meant as the head river of the Satlej. But here again we encounter the common mistake that the Satlej is called Ganges. Wilford is, however, not quite sure about the river which originates from the Manasarovar, as can be seen from the following passage of his:

»The four sacred rivers springing from the Mán-sarovara, according to the divines of Tibet, are the Bramá-putra, the Ganges, the Indus, and the Sitá. The Ganges is the only one that really issues from that lake, or if the three others do, it must be through subterranean channels; and such communications, whether real or imaginary, are very common in the Purán'as. The Sitá may be the Sitodá, Sitlodá, supposed to communicate with the Satlaj or Satodara.»

Thus Wilford arrives at a rather hopeless result in trying to reconcile religious prejudice with geographical facts. In another place he says that the Sitá of the *Purán'as*, also called Para-Gan'dica or Eastern Gan'dica is the Yellow river coming from an eastern lake, Arun'oda or Orin-nor. First he says that the Ganges is the only one really issuing from the Manasarovar. Then that Sitá may be the Satlej, which is a contradiction. On the other hand the Karnali and not the Ganges is, in Tibet, supposed to take its rise from the sacred lake.¹

Speaking of the Indus Wilford says:

»The Indus was supposed formerly to have its source not far from Mán-sarovara, which P. Monserrat² places in thirty-two degrees of latitude North; and the source of the Indus in latitude 32° 15', the difference of longitude between the source and the lake 1° 45'... but what is more surprising, the good father was ignorant that the Ganges issued from it. Abul Fazil places the source of the Indus nearly in the same latitude with Cashmír, but eighteen degrees to the Eastward. The Indus has its source four or five days journey to the North-West of Yárc'hānd, according to Czernicheff; it runs thence in a direction South South-East toward Ládac, and within two days journey of it; nay, merchants, who trade from India to Cáshghar, say it can be done in one day. The Indus then turns immediately toward the West, taking an immense sweep round Cashmír; and the place near Ládac, where it turns suddenly to the Westward, has been mistaken for its source.»

It is curious that Wilford could accept the extraordinary view of CHERNI CHEFF without hesitation.

Of the country round Meru, as given in the *Purán'as*, Wilford says: The mountainous tracts to the North of India, are so little known to us, and to the Hindus themselves, that I can by no means throw any light upon so extravagant and obscure descriptions of them, as are to be found in these Purán'as. The only

¹ As a matter of fact the four rivers are supposed by the Tibetans to flow in underground channels from the lake with only one exception, the Satlej, which periodically flows on the earth's surface.

² Compare Vol. I, p. 154 et seq.

passage he touches upon is about «the famous mountain of Cailása or Cailas, the heaven of Siva, and often used by his followers for heaven in general. Many pilgrims told him that Kailas was 8 or 9 miles south of Rakas-tal, by which they, of course, meant another mountain with the same name.

I must also quote the following passage from the second part of Wilford's *Essay on the Sacred Isles of the West*,¹ dealing with the Gangetic provinces. It seems that, in ancient scriptures, he has found some mention of the routes in southern Tibet. From the Cabolitæ (Cabul) of Ptolemy there was a road, leading through the mountains, north of the Panjab, and meeting another road from Tahora, in the same country at a place called Aris, in the mountains to the north of Haridwár. These two roads are frequented to this day; and they meet at a place called Khama-lang, a little beyond what is called the Eyes of Manasarovar; which are three small lakes, and to the south of Bindu-Sarovara, or Lanca lake. This information I received from several natives, who had travelled that way. The road then goes to Aspacora, or Asparaca, a place in Tibet, mentioned by Ptolemy: there is met with another from the Gangetic Provinces; and passing through Parthona, probably now Kerten, or Kelten, with the epithet of Ponjuling, from which is probably derived the Paliana of Ptolemy.

Wilford tries to identify the ancient names and the distances, but the result is not convincing. He identifies Ptolemy's Thaguri with Tingri, and he quite changes Aspacora or Asparaca, by help of Purangir, into Sipá-gor. It is more like MIRZA HAIDAR's Askabrak, specially Asparaca.² The river Bautisus, Wilford identifies as so many other geographers before and after his time, with the Tsangpo.

But it is useless to lose ourselves in his speculations which very often take him too far. As long as he keeps to the information he has received from natives he is rather interesting and that is why I have paid so much attention to his *Essays*.

¹ *Asiatic Researches.* Vol. IX, 1809, p. 58.

² Compare Vol. I, p. 71.

CHAPTER V.

ELPHINSTONE AND MACARTNEY ON THE SOURCE OF THE INDUS.

In 1808 the British Government in India sent an embassy to Kabul. Besides its political character the expedition also contributed in a considerable degree to our knowledge of the countries situated to the north of its route. Their attempts to locate the source of the Indus are of interest to us.¹

Lieutenant J. MACARTNEY, who was a member of the embassy, was, however, not satisfied with the information obtained regarding the source of the Indus, though some great branches were traced for a very considerable distance, »but not to their source.« He heard that two great branches should join at the town of Dras. The one to the south should be the main branch of the Indus, and so it is also represented on Macartney's beautiful map, although it is difficult to see how he could accept such erroneous information which was indeed very inferior to that brought back by MIR IZZET ULLAH, whose results are discussed in ELPHINSTONE's work.

Not far below the imaginary point he makes the joint river pierce the Hindu Kush or Indian Caucasus, which, on the map, is the direct western continuation of the Hemalleh or Himalaya mountains. On the other hand he is right in saying that the Ladak branch of the Indus had been traced to a great distance to the S. E., for the map was published in 1815, after Moorcroft's reconnoitring in Western Tibet. He has heard that the Ladak branch is also joined by another from the N. W. along which the road to Yarkand was said to lead for 15 days' journey.

Concerning this river, the Shayok, Macartney heard from caravans, that »they crossed the Pamer ridge to the right, and they left this stream (Shayok), which I have heard came from a lake in Pamer, and from its direction being S. E. by E, I imagine it comes from the lake of Surik Kol, as the direction of its course and accounts agree to this lake. This, however, is only a supposition of mine.«

Comparing the Shayok with the Ladak branch he finds that the latter, which »has been traced much further», is the larger of the two, but smaller than the

¹ Mountstuart Elphinstone: »An Account of the Kingdom of Caubul, etc.« London 1815, p. 652.

Dras or left branch. »It appears that from Leh to Rodack (Rudok), a place whence wool is brought to Cashmere for making shawls, the road is along this branch 25 days' journey for the merchants who bring the wool.»

It is not surprising that the rather extraordinary and complicated Indus system has bewildered Macartney. Elphinstone, however, says: »The source of this noble river (Indus) is not yet exactly ascertained», from which he seems to have regarded the whereabouts of the source as approximately known. But from the following passages it is seen how little he really knew, — and of course he *could* not know more at such an early date.

He regards the course of the Indus as traced with certainty only to the neighbourhood of Dras, which Macartney placed in long. $76^{\circ} 48'$, and lat. $35^{\circ} 55'$.¹ To this point the main river was said to come from the north or east, but higher up its course was unknown. The smaller branch, joining at Dras, he says had been traced from Rudok for 250 miles. This is the river they otherwise call the Ladak or Leh branch.

Regarding Macartney's information that the Shayok should come from the Sarikol lake, Elphinstone is not sure of its correctness, for he had been informed by an Uzbek of Fergana, that a stream issued from a glacier in Mus-tagh, on the road between Yarkand and Ladak, and that he followed it from the glacier to the neighbourhood of Ladak, without noticing the junction of any considerable stream from the westward. According to his account, therefore, the river should have its source in this glacier. He will not compare this information with that of Macartney but finds it necessary to call one's attention to the point on account of its obscurity. Only a few years later it was to be proved that Elphinstone had been right and Macartney wrong.

Elphinstone continues:

»It occasioned great regret to Mr. Macartney that he was not able to fix the sources of the Indus; but if we consider the desolate character of the country through which that river runs, before it enters Afghaunistaun, we shall find more reason to be surprised at the success with which he has traced the early part of its course, than at his failure in discovering its remotest spring.

His discovery regarding the course of the river of Ladauk is a point of great interest, and the coincidence between his information and the survey of the Ganges made by Lieut. Webbe (Webb) in 1808, serves to strengthen the authority of both.

It was formerly believed that the river of Ladauk was one of the principal streams of the Ganges, and that opinion was supported by the high authority of Major Rennell; but that eminent Geographer seems to have been led to this conclusion by the erroneous accounts of the Lamas, and of P. Tiefentaller. Captain Raper and Mr. Webbe were sent on purpose to ascertain the source of the Ganges, and found it to be in the SE side of Hemalleh; far to the south of what was formerly supposed. It was now proved that the river of Ladauk did not flow into the Ganges, but its real course remained unknown, till Mr. Macartney ascertained its junction with the Indus near Draus.»

¹ Op. cit. p. 109.

How uncertain he really was regarding the situation of the source of the Indus can be seen from the following note:¹ «It is possible that the streams which are said to issue from the lake Mansaroor to the south of the river of Ladauk, may be the main stream of the Indus.» There can be little doubt that this passage was written before Elphinstone knew the results of Moorcroft's journey in 1812. But it may be a confusion with the Sutlej, which really issued (about 1800) from the Manasarovar, and is situated south of the Indus.

¹ Op. cit. p. 110.

CHAPTER VI.

COLEBROOKE, WEBB AND RAPER ON THE SOURCE OF THE GANGES.

D'Anville's Lama map was a great step forward, not only directly, by the new information it gave of the geography of Tibet, but also indirectly, by the impulse it gave to new exploration on the frontiers of this mysterious country. In some parts nothing was added to d'Anville's map for more than a hundred years, but in other parts the authority of the map was shaken by detailed exploration carried out by Englishmen. A question that especially interested English geographers was the situation of the source of the Ganges, and as this question, as I have shown before, very intimately comes in contact with our lakes, I cannot help quoting some passages in an article by H. T. COLEBROOKE.¹

His article is an introductory note to a narrative of a journey, the object of which was to find the real source of the Ganges. Lieutenant-Colonel COLEBROOKE disbelieved the authority and information on which, ever since d'Anville's time, the origin of the Ganges had been traced on maps and H. T. Colebrooke examined the material existing at his time.

When Anquetil du Perron, in 1776, had pronounced the Lamas' work to be faulty, erroneous, and unworthy of credit, Colebrooke finds his arguments to be forcible and convincing, and points out that the sources and subsequent course of a river could evidently not be laid down from oral information, collected on the opposite side of a chain of lofty mountains, in which it was said to take its origin. That such information, hastily gathered by inexperienced geographers, as the Lamas were, must be grossly inaccurate, seemed indisputable. They did not pretend to have seen any part of what they described. Their route, says H. T. Colebrooke, does not approach nearer to the celebrated lake Mapama than a quarter of a degree, and terminates at a mountain marked M. Kentais, which is the name of a chain of mountains known to the Chinese as the western range in Tibet, and which is ex-

¹ :On the Sources of the Ganges, in the *Himádri or Emodus*, Asiatic Researches, Vol. XI, 1812, p. 429 et seq.

hibited in d'Anville's map, and in the still ruder copy of the Lama's original delineation, published by SOUCIET (Vol. I, Pl. LIII), as intervening between their last station and the lake.

As I have shown before, such a view as Colebrooke's cannot be correct. But all he finds deducible as authentic information, is »that the lamas reached the chain of mountains which forms the south-western boundary of Tibet; and halting at the foot of the range, learned, from the inquiries which they there made, that the Ganges takes its rise in the opposite side of that chain of mountains. But the whole of their sketch of the river's course, from the 36th degree of longitude (from Peking) where their route terminates, to the 43d, in which they make the two furthest branches of the Ganges turn due south after a westerly course, and thence return by an easterly course to the same longitude, with little difference of latitude, must be deemed vague and imaginary, being at best founded on oral information, and very imperfect notices, hastily collected in a season of danger and perturbation.»

Colebrooke regards Tieffenthaler's results and maps as not undeserving of attention. But he points out that Tieffenthaler had not surveyed in person the course of the Sarayu, although the Father made it rise from the Manasarovar, nor had he seen the Ganges above Dévaprayága, although he delineates its course to the Gangotri. Major Rennell believed that Tieffenthaler had himself taken the latitude 33° for Gangotri and accepted it on his map, where he tried to adjust to that position the supposed course of the Ganges as it came out from the lake Mapama of the Lamas, »imagined to be the same with the Mánasarávara», and down to the cataract described by Tieffenthaler at Gangotri. Colebrooke finds it strange that Rennell could suppose that Tieffenthaler had visited Gangotri in person, as Anquetil du Perron positively says he did not. In the second edition of his *Mémoire*, 1792, Rennell had detected the error in Tieffenthaler's report, and therefore distrusted the rest of his information. Rennell now concluded that Alaknanda was the chief branch of the Ganges, and had its source in the snowy mountains of Tibet. And as to the source of this river he regards Kang Hi's Lamas as the most reliable authority in existence. Their report is defective in geometrical exactness but in plain matter of fact it is trustworthy. And they had reported that the river issued from the lake Mapama and went westward. He thinks Tieffenthaler's messenger unintentionally corroborated this report.

In conformity with this notion, Colebrooke points out that most maps which had afterwards been published, as for instance ARROWSMITH's map of Asia in 1801, and of India in 1804, represented the Ganges within the chain of snowy mountains flowing for hundreds of miles from lake Mapama to Gangotri. And both Colonel Colebrooke and H. T. Colebrooke suspected that this notion, founded on the Lamas' exploration, rested on very slender and unreliable information. They found it extraordinary that Desideri and Freyre, who stayed nearly two months in Ladak, should not even mention such a remarkable circumstance as the Ganges flowing past the

town (Leh), so much the more as those missionaries followed the river up for a long distance.

Rennell acknowledged that it was believed, on the faith of the Hindus, that the source of the Ganges was situated at the foot of the Himalaya, until Kang Hi sent his expedition, the report of which changed the opinion in Europe. Therefore Colebrooke concludes, that the conjectural basis of a geographical fable may, to a certain extent, be used as a guide to inquiry and research. And he continues:¹ »Upon this principle, it might not be unreasonable to institute researches, with the view of ascertaining whether any lake exists within the snowy mountains, an imperfect knowledge of which may have been the foundation of the fables concerning the Mānasa and Vindusaróvara lakes of the Hindu poets, and the Mapama and Luncadeh of the Lamas: and, if any such lake exist, whether a river issues from it, as generally affirmed; and whether that river be the Alacanandá, as hinted not only in Puráñas but in the astronomical work of Bha'scara, or the Sarayu, as intimated in other Puráñas, and as affirmed both by Pra'npu'ri² and by Tieffenthaler's emissary.»

As a result of the whole discussion it was found that Hindu pilgrims had followed the Ganges from India up to the snowy mountains, and from the north the Lama surveyors had reached Mount Kentaisse. We have, however, seen before that the Lamas would never have been able to lay down on their map the lakes and rivers in such an excellent way as they did, unless they really had been there. But in Colebrooke's time nothing was known about the country beyond the mountains and it is easy to understand why he could not find out the single and simple cause of the mistake: the Ganges instead of the Satlej. Therefore he regarded the intervening region between the Kentaisse and the southern foot of the Himalayas as unknown, although at least a part of it was comparatively well known from the survey of the Lamas. Colebrooke, however, still finds room for the supposition of a lake interposed, out of which a branch of the Ganges, perhaps the Alaknanda, might really issue, conformably with the whole current of popular belief. And therefore, he thinks, a journey to the remotest accessible source of the Ganges was an undertaking worthy of British enterprise. Perhaps the national credit was concerned, not to leave in uncertainty and doubt a question which the *English* only have the best opportunity of solving: and one at the same time so interesting, as that of exploring the springs of one of the greatest rivers of the old continent, and whose waters fertilize and enrich the *British* territories, which it traverses in its whole navigable extent.»

The journey to the source of the Ganges was to be undertaken by Lieutenant WEBB with Captain RAPER and Captain HEARSAY, and was carried out in 1808.³

¹ Loc. cit. p. 439.

² Probably Purana Poori as above, p. 10.

³ Ritter relates Colebrooke's discussion and the most important results of Webb's and Raper's expedition thus: »Der Ganges entquelle nicht dem Nordgehänge der hohen Schneeketten des Himalaya.

On the results of his journey Webb wrote to Colebrooke: Considering the most important information gained, to be a knowledge that the sources of the Ganges are southward of the Himálaya, I subjoin my reasons for adopting this opinion. And he gives the reasons why it is proved by his journey that the source or sources of the Ganges are situated on the southern side of the Himalaya,¹ and he adds, that from intelligent natives he had their assurances, that no river, except one, exists westward of the Mánasáróvara lake; that this stream is called the Saturuz (Satalaj) river; and that it turns southerly west of Jamoutri.²

Although Webb had no opportunity to visit the lakes himself, he was clever and critical enough to gather reliable information about them, and he had a very sound and clear view of the complicated hydrography.

Colebrooke agrees with Webb, but it is difficult to understand his entire meaning in saying: it is presumable, that all the tributary streams of the Ganges, including the Sarayu (whether its alledged source in the Mánasarovara lake be credited or disbelieved), and the Yamuná, whose most conspicuous fountain is little distant from that of the Ganges, also rise on the southern side of that chain of mountains. From the western side of the mountains, after the range, taking a sweep to the north, assumes a new direction in the line of the meridian, arise streams tributary to the Indus, and perhaps the Indus itself. On the other hand he is right in finding it probably true, that the sources of the Sampoo or Brahmaputra and its tributary streams, are separated only by a narrow range of snow-clad peaks from the sources of the rivers which constitute the Ganges, or which serve to swell its stream.

Colebrooke finishes his highly interesting and able remarks in pronouncing an opinion which is not strange for 1810, namely, that probably no other mountains than the Cordilleras de los Andes were higher than the Himalayas. In another article³ he explains the causes why he thought it wise to speak of the Himalayas as only second in height.

On a later occasion Webb got another piece of reliable information about the sacred lake. It was in 1816 when he ascended the then almost unknown passes,

ondern den Sudgehangen; sein Lauf sei also weit kürzer und unmittelbarer Hindostan angehörig, als die Lamakarten es vorstellten; d'Anville's und Rennell's Karten über den obern Lauf des Ganges konnten ferner nicht mehr gelten, da es nun schon, nach den Erkundigungen, ausgemacht war, dass der Strom, der aus den heiligen Seen, im Norden der Haupt-Schneekette gegen West fliessse, nicht der Ganges, sondern ein anderer Strom sey, welcher? das blieb noch unbekannt. Aber der Ganges, so viel schien, und dies war auch Colebrooke's Ansicht, entschieden, stehe nicht mit den heiligen Seen (Manas-Sarowara etc.) der Plateauhöhen in Verbindung, eine Vorstellungswise, zu welcher seit ältester Zeit die Hindu-Mythe vom Meru, Kailasa und der heiligen Ganga verführt hatte.» Die Erdkunde von Asien, Band II. p. 501.

¹ As I have mentioned above, WEBB does not seem to have known that almost 200 years earlier Antonio de Andrade had made the journey up the Ganges and not only reached the pass of Mana, but even gone beyond it. Vol. I, p. 163.

² Loc. cit. p. 433.

³ »On the Height of the Himálaya Mountains.» Asiatic Researches, Vol. XII, 1818, p. 253 et seq.

Lebug, on the source of the Kali Ganga, and the Taklakot pass on the source of the Gogra. But he did not reach the Taklakot pass itself, and the *Deba*, who received him kindly, said, under no conditions would he be allowed to go to the Manasarovar. The *Deba*, however, told him, that more than 100 rivers emptied their water into the Manasarovar, though the lake had only one affluent to the Rawan-hrad, a channel, which, however, was often dry.¹

This description by the *Deba* is of special value, as it gives the real and correct key to the whole problem and it proves that the characteristics of the channel were the same a hundred years ago as they are now, that is to say, that the function of the channel is simply a periodical phenomenon, and that a hundred years is much too short a time to prove the existence of a general postglacial desiccation.

The information of the *Deba* as given in 1816, should also be compared with Moorcroft's exploration in 1812, as it corroborates the latter's results and makes it still more superfluous to later geographers to explain the causes why he did not find any channel at all.

In his article: *Memoir relative to a survey of Kemaon*,² Captain Webb gives an approximation of the co-ordinates of the Manasarovar as follows: latitude: $30^{\circ} 23' 7''$, longitude: $81^{\circ} 9' 10''$, elevation 14,500. He finds it probable that his latitude and longitude will fall somewhere within the limits of the lake itself, especially if it be remembered, that the place where his information was obtained, was not so much as twenty miles distant from the Manasarovar. It is true that his approximation is not far from correct, but he could easily have dropped the seconds.

On the journey to the source of the Ganges, Captain F. V. Raper wrote a long and most interesting paper,³ which gives a detailed description of their exploration up the Bhágiráthi and the Alacananda. The journey is of very great importance as showing the geographical and water-parting rank of the Himalayas and that there really was a tremendous »Range of Mountains« north of India and that the Ganges came from it. An excellent map, dated 1810, is joined to the paper. The supreme government of Bengal had given Webb special instructions in 8 §§, of which § 2 ran as follows: »To ascertain whether Gangotri be the ultimate source of the Ganges; and in case it should prove otherwise, to trace the river, by survey, as far towards its genuine source as possible. To learn, in particular, whether, as stated by Major Rennell, it arises from the lake Manasarovar; and, should evidence be obtained confirming his account, to get, as nearly as practicable, the bearing and distance of that lake.»

Amongst other results of the expedition I will only mention that it obtained information about the trade routes used by the Nepalese with Tibet. Raper men-

¹ Ritter, *Erdkunde von Asien*, II, p. 529.

² *Asiatic Researches*, Vol. XIII, 1820.

³ »Narrative of a Survey for the purpose of discovering the Sources of the Ganges.« *Asiatic Researches*, Vol. XI, 1812, p. 446 et seq.

tions four »distinct G'hátis: Tagla-Cot'h and Dhumpú from Kumaon, and Lit'hi-Dhába and Mánah, both from Gerwal to Dhába. From Dhumpú it was said to be four *manzils* to Gertokh, and Lehdac was found to be situated to the west of Gertokh.

The most important result was, however, that an end was put to the mistake of the Ganges coming from the Manasarovar. Thence forward the source of the Ganges was placed at the southern side of the Himalayas, but the problem of the Manasarovar and its river was still left to be solved.

CHAPTER VII.

WILLIAM MOORCROFT'S JOURNEY TO THE MANASAROVAR.

We now come to one of the most brilliant chapters in the history of exploration round the lakes and the sources of the great rivers.

WILLIAM MOORCROFT was a native of Lancashire and educated at Liverpool for the profession of a surgeon. He settled in London as a practitioner of veterinary surgery, and there received an offer from the Court of Directors of the East India Company to go out to Bengal as superintendent of their military stud. Thus he left England in May 1808 for India. He was a man with very wide and broad views and his ambition was to open to British industry countries in most of which British manufactures were at that time wholly unknown. In a letter written in the mountains of Garhwal, Dec. 27th 1819, he says that he had heard from reliable sources in Calcutta, »that little extension of commerce in the direction he had taken was reasonably to be expected, because the intercourse of the Cis and Trans-Himalayans had never been active.» He observed that the trade from British India to Yarkand and Lhasa was wholly in the hands of Kashmir, and, after several years of hard work he was justified in saying: »If I fall, my country will set a due value on my motives, and at least allow me a claim to disinterested perseverance.

Another ambition of his was to improve the breed of horses in Hindustan, and introduce English and Turkman stallions, instead of Arab. Therefore, on his second great journey he crossed the Himalayas and went to Balkh and Bokhara, to find the best Turkman horses. On this journey he was provided with a great stock of merchandise, with the revenue of which he intended to buy horses to be sold to the Government. In a double way he would serve his country, but the principal aim was to establish a commercial intercourse with the Trans-Himalayan districts, which would be highly advantageous to Great Britain.¹

¹ Travels in the Himalayan Provinces of Hindustan and the Panjab; in Ladakh and Kashmir; in Peshawar, Kabul, Kunduz, and Bokhara; by Mr. William Moorcroft and Mr. George Trebeck, from 1819 to 1829. Published by H. H. WILSON, London 1841.

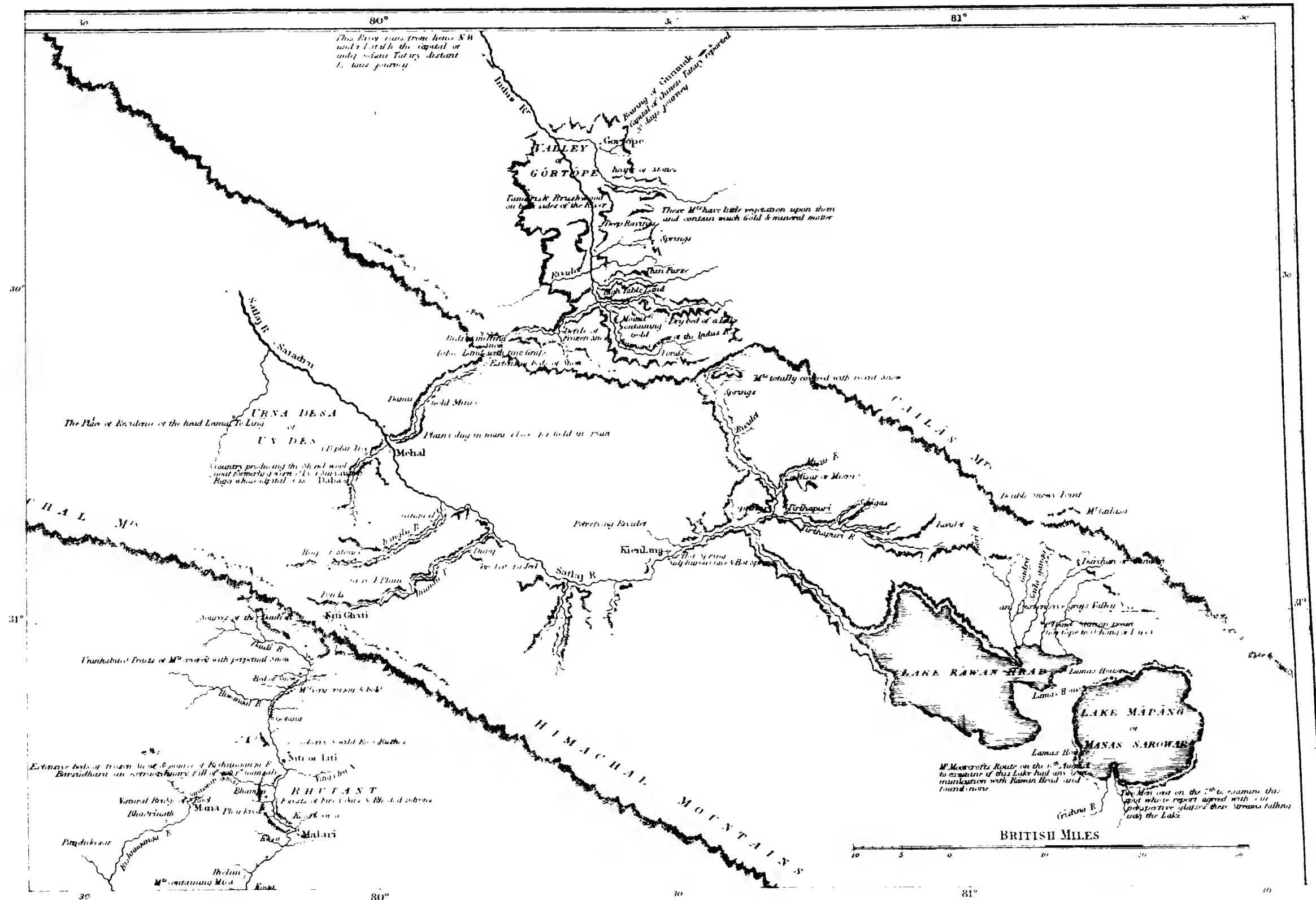
But here we are concerned only with the first and by far the most important of Moorcroft's journeys.¹ He has described it in a most excellent and conscientious way in an article, which was presented to the Royal Asiatic Society of Bengal by H. T. Colebrooke.² The motive of this first journey was to open to Great Britain means of obtaining the materials of the finest woollen fabric, but the result was, as Colebrooke puts it, that Moorcroft and Captain HYDER HEARSAY brought back, with indefatigable perseverance and admirable intrepidity an interesting accession of knowledge of a country never before explored. By this journey one of the most important geographical and hydrographical problems of Tibet and India was, at any rate, solved in a preliminary way. With the knowledge Europe then possessed of these regions, Colebrooke could not appreciate the value of Moorcroft's journey to its full extent. This has only been possible during recent years. Therefore, in his introductory note, Colebrooke states that the two travellers ascertained the existence, and approximately determined the situation of the Mánasaróvara, verifying at the same time the fact that it gives origin neither to the Ganges, nor to any other of the rivers reputed to flow from it. And who would not excuse Colebrooke for a misunderstanding which was entirely founded upon the description given by Moorcroft. For now we know that the Satlej comes from the lake, although its channel happened to be dry in 1812. And Colebrooke carefully adds: »Mr. Moorcroft, as will be seen, found reason to believe that the lake has no outlet. His stay, however, was too short to allow of his making a complete circuit of it: and adverting to the difficulty of conceiving the evaporation of the lake's surface in so cold a climate to be equivalent to the influx of water in the season of thaw from the surrounding mountains, it may be conjectured, that, although no river run from it, nor any outlet appear at the level at which it was seen by Mr. Moorcroft, it may have some drain of its superfluous waters, when more swollen, and at its greatest elevation, and may then, perhaps, communicate with Ráwan lake, (in which the Satlej takes its source) conformably with the oral information received by our travellers.» Colebrooke never knew how true the theory was which he conjectured in these words.

In publishing Moorcroft's report, Colebrooke has made use of his liberty of selection from the original diaries and he has been more complete in those parts which were wholly novel. We may be sure that his selection has been carried out with the greatest care and that nothing of importance has been omitted.

On the journey, Hearsay carried the compass and brought up the rear, and Harkh Dev Pandit was directed to stride the whole of the road at paces equal to 4 feet each.

¹ »A Journey to Lake Mánasaróvara in U'n-dés, a Province of little Tibet.» By William Moorcroft, Esq. Asiatick Researches, Vol. XII. London 1818, p. 380 et seq.

² Colonel HUGH PEARSE has reprinted an extract from Moorcroft's diary which does not contain any new or interesting views of this important journey. »Moorcrofts and Hearsay's visit to Lake Mansarowar in 1812». Geogr. Journal, August 1905, p. 180 et seq.



Moorcroft's and Hearsay's map of the Lakes. 1812.

They went up the Dauli to Malári and Nítí where they had some difficulties with the chief who suspected them to be either »Gorkhalís or Firingís» and wondered whether their arms and great number of men meant hostilities to Undes. But they informed him that they had come for pious and humane purposes to visit the lake of Mánsarówar.

Seeing the mighty mountains, Moorcroft remarks that such a surface of mountainous country in such a state, along with the vast declivity of the beds of the rivers, will afford a more satisfactory explanation of the real sources of the Ganges than by supposing it to come from a lake which must have some continual source of supply itself.

After a long delay (June 4—24) they left Niti and continued up the upper Dauli, the sources of which they left to the west. On the right bank of the river they principally saw granite of a green colour. They passed the last birch, left the Dauli behind, and commenced ascending the Ghatí or pass which separates Hindustan from U'ndés, or Hundes. On the Niti Ghati they were glad not to find any resistance from Daba. The height of this pass was found to be so great, that a small body of resolute men might almost defend it against a large army, merely by rolling down stones. North of the pass was a river called Jandú.¹ The plain around was very broad and intersected by deep and broad ravines. As all of them ran to the north and east, they were considered to be the sources of those various streams, which, joining in their course, give rise to the Satlej.

Farther on, on the road to Daba, he could see to the east the sacred mountain near the lake of Mánsarówar, tipped with snow, and called Cailás or Mahadeó ka Ling. The morphologic difference between the river-courses north and south of the main ridge of the Himalayas does not escape his attention, the northern ones being much broader and more open and sloping gradually. Speaking of the great plain he had now reached, he says that it is bounded on the south by the last Himalayan ridge, and on the north by the Cailás mountains with snow summits and easy slopes to the plain. Behind, the mountains seem to meet in an angle near Mahádéva ka Ling.

On July 3rd they reached Daba and left the place again on the 12th, on the way to Ghertope or Gartok, where the military chief wished to see them and their merchandise. This way took them to a plain sloping to the Satúdrá or Satlej. They crossed the river. Before reaching Gartok, the party came to a river, which rises near Gongré, goes past Ghertope, then close to Laták or Ladak, and was said likewise to proceed to Bokhara, where it was supposed to fall into the Ammoo, Djihon or Oxus. He did not remain very long in this error, for already in Gartok he wrote in his diary: »I must here remark that the river, which goes from Ghertope to Laták, does not proceed to Bokhara as before

¹ Jhündu on the map, Pl. III.

stated; but falls into the Attock, or more properly speaking, is the main stream of that river.¹

In Gartok, Moorcroft found some black tents round the house of the »Déba or Garpan». His description of Gartok as well as that of Daba shows that these places have not changed in the least during 100 years. The *Garpan* did not take the travellers for Europeans and does not seem to have caused them any difficulties. He only told them not to take any other road than the usual one to the Manasarovar, and not to stay at the place more than one or two days. Thence they should proceed to Gangri, Hienlung, Daba and the Niti pass. Moorcroft tried to get permission to return by another pass than the Niti, but in vain. The *Garpan's* head would be forfeited if he let them take another road than the one by which they had come, — exactly as at the present day!

At Gartok they met merchants both from Ladak and Kashmir. Moorcroft mentions the growing trade of Russia with Yarkand and says her agents even come to Kashmir. The Russians themselves were said not yet to have proceeded so far as to Ladak, but 500 or 600 Russians on horseback were reported to have visited the fair of Gartok. If that be true, Moorcroft thinks that the Russians must reach Gartok by another route than that of Yarkand. From Ladak it was said to be 30 days to Yarkand where much better horses are found than in Hundes. Ladak was said to be 10 or 12 days' journey from Gartok.²

After six days' stay in Gartok he proceeds towards the S.E., crosses a pass and then a branch of what he calls the Satúdrá river. At Misar he bought a good deal of wool to hide and mask his real intentions, but he also regards that day as the epoch at which may be fixed the origin of a traffic »which is likely to be extremely beneficial to the Honourable Company». Misar was found to be situated upon a rising ground on the left bank of a rapid stream, forming one of the branches of the Satúdrá or Satlej. By branches he here obviously means tributaries, as the brook of Misar, which only after rain may be considerably swollen, cannot possibly be regarded as one of the sources of the river.

The next place on his route is Tirtápuri, the residence of a Lama and several *Gelums*. Steep, craggy, limestone rocks in a state of decomposition overhang it. At Tirtapuri he was told that immediately at the foot of the rock, on which the monastery is built there runs a very rapid stream which proceeds from a lake at the foot of the Himalaya, called Ráwanhrád; it constituted the principal branch of the Satúdrá.³ On his map, Pl. III, he has drawn the hydrography in quite a different way. As there was no water in the channel between the two lakes in 1812, it is of course

¹ If such information as the first mentioned could be given on the very banks of the Indus, we may forgive the Lamas if they believed in the information that the same river belonged to the Ganges.

² As many other travellers and geographers in those days, Moorcroft calls the Tibetans, Tatars.

³ Loc. cit. p. 462.

impossible that any river could issue from Rakas-tal; the channel must be quite full of water, before the Satlej goes out of the western lake. Still it is interesting to notice that the Lamas of Tirtapuri regarded the river as coming from that lake, showing that the periodical fluctuations did not interfere with their view.

Two days farther on, at the foot of the mountains to the right, he beheld a large sheet of remarkable blue water, called Ráwanhrad, said to give rise to the principal branch of the Satúdrá, and to communicate by a river with the lake Mánasarówar, named by the natives Mapang. This was written before he had reached the Manasarovar, where he should see that there was no communication at all between the two lakes. As to the Ráwanhrad and the Satúdrá he was never to get an opportunity to control that statement.

In his camp at Gangrí or Darchan he observed that »a cascade issues from the rocks just above Darchan, and falls into the Ráwanhrad, which is supplied by the melting of the snow on the great mountains at the foot of which it is situated. It is said to surround a considerable extent of mountains, insulating them completely; but this, being the relation of natives, is to be received with caution.»

On the 5th of August they left Darchan and crossed a stream which in five or six branches comes down from the Cailás mountains and disembogues into the Ráwanhrad. Finally the Manasarovar was visible and the party camped near a house inhabited by *Gelums*, which cannot be anything else than Langbo-nan-gompal

Moorcroft remarks that this lake is the most sacred of all places of Hindu worship which he believes depends upon its difficulty of access, its distance from Hindustan, the dangers of the road, and the heavy expenses of the journey for the pilgrims.

Moorcroft has not been able to find out why the lake is called Mapang by the »Unias or Chinese Tatars». As Hindu geographers had derived the Ganges, the Satrúdrá and the Kálí or Gogra from this lake, and as Moorcroft believed no other European had ever visited it before, he was anxious to settle the question about the two last-mentioned rivers. For, as he says, from his own observation and from those made by Raper, Webb and Hearsay, it was quite clear, that the Ganges derives its supplies from the melted snow of the Himálayas, and that it does not receive the smallest streamlet from their extreme northern face, nor from a source to the north of them.

Moorcroft was not the first European at the Manasarovar as he believed. Desideri and Freyre had been there before, but the detailed narrative of Desideri was unknown, and in his letters he does not mention the lake; Moorcroft was, at any rate, the first scientifically trained European who ever reached the place.¹

¹ H. H. Wilson, Op. cit, Preface p. XVII. It is more curious that the learned professor Wilson could forget the many Catholic missionaries who had crossed the Himalayas, when he says of Moorcroft: »In this journey (1812) he was the first European to cross the Himalaya, and make his way to the great plain between that and the Kuenlun chain, the situation of the sources of the Indus

Moorcroft knew perfectly well the controversy or rather problem of the lakes, for already in his days it was a geographical question of great interest. He went to the western shore of the Manasarovar with the intention and desire to solve the problem definitely. Here he was not a wool-merchant, but a scientific geographer, who gave extremely important and very valuable additions to the geographical knowledge of his time. He has not always got the credit he ought to have. But I will prove presently, that his journey was not only the first in these regions undertaken by a scientifically trained and critical traveller, but also that the observations he made give us a valuable help in our attempts to reach clearness in this most interesting hydrographical question.

Moorcroft must really have felt somewhat bewildered when he compared what he saw with his own eyes with what he heard from natives. Thus HARBALLABH, the old Pundit, reported that near the south-western corner, a river issued from the lake which, flowing in a westerly direction, went along the Ráwanhrad, and, escaping from its western extremity near the foot of the great mountain, formed the first branch of the Satlej. But when Moorcroft himself, on August 5th, went up on a hill near the shore, from where he could see most of the western shore of the lake, he could not see any outlet, unless a projecting rock at the S.W. angle concealed one from his view. Determined not to leave this point in doubt, he went on foot along the shore, on August 6th, although he was weak after frequent attacks of fever. He gives an excellent description of the N.W. shore which he followed along the foot of the cliffs, from the face of which great heaps of »red and green granite, marble, and lime-stone had fallen.» He saw the grottoes and caves which still exist. In the N.W. corner of the lake he went to the bay at the foot of the hills, from the bottom of which rose a pyramidal red rock, connected with a line or ridge of high land to the higher flats to the north, and steep towards the south. Upon this was the house of a Lama and many *Gelums*, pitched in situations which produced a romantic effect. This description of Chiu-gompa is also very well given.

The following passage is of special importance:¹ »Leaving this (the hill of Chiu-gompa) and diverting my steps to the south, I went along the base of granite rocks amongst such troublesome, rugged and slippery stones, as had interrupted my progress in the outset, till I reached a high, level, and firm bank, which separated

and the Setlej, and of the two remarkable lakes of Rávan and Mánasa.» In the notes to the second edition of his translation of the Megha-düta, 1843, Wilson says (p. 66): »Mánasa, Mánasarovara, or commonly Man-sarour, is a celebrated lake situated in the centre of the Himalaya mountains, and was long said to be the source of the Ganges and Brahmaputra rivers: with respect to the first of these, the statement has been found to be erroneous; and we have no positive proofs of its accuracy with regard to the latter. When the passage in text was translated, — (the first edition of Megha-düta appeared in 1813) — the chief information regarding the latter was derived from the vague reports of Hindu Pilgrims. Since then, Mánasarovara was visited by that enterprising traveller, Moorcroft. He has not yet had a successor.»

¹ As. Res. loc. cit. p. 470.

the water of the lake from that which accumulated by the slope of the surrounding upland, directing the melted snow into it. At the end of this natural barrier I saw a point of rock running into the lake, from the top of which I flattered myself I should have a prospect that would command the whole of the shore to the southwest corner, and put an end to a task which I now found somewhat too much for the little strength I possessed. But I was severely disappointed: for on mounting a steep hill, of which the point in question formed the front to the lake, another large mountain intervened to prevent my view, with a deep valley between it and that which I had too hastily concluded would finish my labour. When I had reached the summit of this, another equally high presented itself.»

At 4 o'clock he reached a height, from where he could see the whole of the rest of the shore except a little bit hidden by a high promontory. To that place he sent one of his men to look out for an outlet. In the meantime the weather cleared up and he got a better view of the shore, except the hidden part. Numerous traces of water-courses were leading into that place, the most important of them being the Krishná, sweeping down a ravine between two high mountains of the Himálaya range, and expanding like a sheet as it approached the verge of the lake; but not a break, nor any other appearance indicated the escape of any river or even of any small stream from it. — Although this was clear enough to the naked eye, he employed a telescope; and this as well as the evidence of two servants who gave him an account of what they saw, showed that the Manasarovar sends out no rivers to the south, north or west.

When returning he descended to the shore. There was a yak track, as is usual nowadays. If the lake had been much higher than in 1907 this track would have been rather difficult to use. By a hard wind the surf was thrown so high on the shore as to efface all traces of the path, and leave scarcely room enough to pass between the face of the rock and the water. There are some places of that kind even now, both near Gossul and Chiu. During one of his many halts, Moorcroft was overtaken by the reconnoitring man, who reported that he had gone almost to the foot of the Himalaya mountains, and had not seen the slightest trace of any river issuing from the lake.

It is hardly possible to give a better general description of the north-western shore line of the lake than Moorcroft has done, and, in spite of his illness, he here accomplished a very good piece of work. There are some points which must be discussed in order to understand him better.

He says positively that, leaving the *gompa*, he went to the south. Thus he must have crossed the channel south of the *gompa*, and not at the very shore of the lake. But as soon as he reached the foot of the rocks, just south of the *gompa*, he followed it, and thus necessarily came down to the edge of the lake. He kept on marching what must have been 4 miles till he came to the high, level and firm bank, which was afterwards described by Strachey. There is no other

bank on the west shore of the Manasarovar than this, at least not during dry years. There was a salt pool in 1907 inside of this bank. South of it, Moorcroft saw a rock running into the lake, as is really the case. He ascended this hill, always in search of an outlet. He went up one hill after another and finally arrived at a small religious pile», his southernmost point. On his map this place is called Lama's house and cannot be anything but Gossul-gompa, $7\frac{1}{2}$ miles south of Chiu-gompa. His camp at Langbo-nan was $6\frac{1}{2}$ miles from Chiu-gompa, and thus he had gone 14 miles in 6 hours, which is not bad considering his fever. After having in vain looked out for an outlet with his telescope he returned in 7 hours. By reckoning the steps of his men he calculated the total distance, coming and going, at 27 miles.¹

Now the situation is as follows: he is searching for the presumed outlet in the south, but he had already crossed its bed at noon, without seeing it. He had undertaken his wandering along the lake especially in order to find the outlet, if there were any, and to definitely solve the problem. At every turn of his road he is examining the ground, but cannot find the slightest sign of a channel. There is nothing arousing his suspicion. And still, a minute after leaving Chiu-gompa, he crossed the bed! At about nine o'clock in the evening he crossed it again on his way back, but then it was dark. He had some of his servants with him. They knew what he was searching for, but could not assist him in finding any outlet, although they knew that such a discovery would have pleased him.

On August 7th he again sent his young Pundit HAR DEO and another servant along the western shore, and on their return they stated that they had not found any appearance of a river issuing from the lake, or of any former bed of a river which had escaped from it. That is to say: the real former bed was crossed four times by several men, and probably not on exactly the same track, and none of them could see the dried up outlet of the lake.

And still, just for that reason, the puzzle is very simple. There *was* no issuing river in 1812. The lake was at a depression in its periodical pulsating of high level and low level, depending upon a periodicity of precipitation, which also influences all other lakes in Tibet as well as all the glaciers in the Himalayas, Karakorums and other mountains north of India. We may trace this periodicity in the retreats and advances of the snouts of the Ak-tash and Kumdan glaciers, in the more or less great difficulty in crossing certain passes in the winter, in the longer or shorter duration of the passes being closed by snow, in the duration and abundance of the monsoon, in the rains, famines, harvest etc. in India. All these and several other phenomena depend upon one and the same cause, whether it be a terrestrial or cosmic one, which is still unknown to us.

Under such circumstances it is superfluous to try and explain Moorcroft's observations in any other way. Dr. Longstaff makes the following suggestion:²

¹ On my map I make it 28 miles.

² Geographical Journal April 1909, p. 426.

»The reason Moorcroft did not find this channel is quite simple. In his anxiety to miss nothing, he walked along the actual lake side of Mansarovar, and the shingle bank over the effluent channel, beside which he was walking, effectually concealed that channel from his view.» This suggestion reminds one very much of Richard Strachey's saying that as Moorcroft »walked along the edge of the lake, his eye would have been so near the level of the water that a very small irregularity of the beach might have concealed the course of the stream from his view.»

To this I will remark that Moorcroft did not walk along the actual lake side from Chiu-gompa to the point from which he returned. It is true that he went down to the shore from the temple, but then he had already crossed the bed of the channel, which is the important point. Farther on he went along the top of the hills, so much so, that he even complains of intense thirst.

In 1907 and 1908 there was not the slightest sign of any »shingle bank over the effluent channel». The hard bank Moorcroft speaks of lies some miles farther south and is permanent, whether the lake be high or low. SHERRING says that »storms blowing from the east have thrown up sand at the mouth of the passage to a height of about 4 feet.¹ This may have been the case at the time of his visit (1905), but in 1907 there was no such wall. Eastern storms are rather rare and as they come from over the lake, they are not likely to build up any sand walls at such a place as this, which, as a rule, is exposed to the western storms, by which the moving sand is blown out into the lake. But even if there had been a sand wall of some feet in height in 1812, it could not possibly have hidden the channel from Moorcroft's view. In 1907 one could lie down upon the ground at the edge of the lake or at some distance from it, and, turning east, see the surface of its water, and, turning west, see the beginning of the then dry channel. But there was not even a rudiment of a beach of any kind, although some sand had been swept by the winds into the bed of the channel.

In 1848 there was »a raised beach» cut through by the effluent channel. Such beaches seem, under certain conditions, to be formed by the breaking up of the ice in the late spring. After an exceptionally cold winter, the still thick ice may be broken up by hard winds occasionally blowing from the east, and then the pressure of the ice will press up the mud of the lake on its edge and thus form a regular wall round the N.W. bay, where the conditions for its formation are favourable, and where the strand slowly rises and the lake is shallow.²

But Moorcroft has not a word to say of any such wall near Chiu-gompa. Even if there had been a raised beach in 1812, which is extremely unlikely, it ought to have been pierced by the bed of the effluent, as it was at the time of Strachey's

¹ Western Tibet, p. 272.

² Such was the case, in December 1901, at certain parts of the northern shore of Panggong-tso and Tso-ngombo, the lake of Noh. As such a wall consists of mud, it will disappear in a few years, from rain, frost, wind and waves, and, occasionally, from the rising of the lake.

visit. Strachey and other explorers who have visited the interesting place, are probably adherents of the theory of a regular and constant desiccation. If there was a strong channel in 1846, and a small one in 1848, there must have been a very considerable effluent in 1812. Therefore they try to explain Moorcroft's statement in their own way, and they forget the periodicity of the phenomenon. If they were right, Moorcroft, who always travelled with his eyes open, would have been extremely sleepy just on the most important occasion of his journey. And it is no use making his illness responsible for it, as it could not be very serious a day, when he was able to march 27 miles on foot. Reliable and scientific observations on the shores of the Manasarovar are so extremely rare, that the few in existence should not be spoilt by speculation. Moorcroft saw no channel in 1812, because there was none; that is all we need to know.

On the morning of August 7th Moorcroft sent for Harballabh, the old Pundit, and told him that the river the Pundit had crossed on a bridge 16 years earlier, or in 1796, did not proceed from the Manasarovar, but from some part of the Himalaya to the west, and, suddenly taking a western course, fell into Ráwanhrad, and led him into error on this point. Harballabh was, however, very positive on the subject, and said he could bring the evidence of all the inhabitants of the neighbourhood in support of the truth of his assertion, and that Moorcroft's scout had not gone as far as he had been ordered to do.

It was to settle this matter that Moorcroft again sent out his men in search of the mysterious channel, but always in vain. It is a pity he did not ask Harballabh to show him the bridge, which was situated quite close to Chiu-gompa as it is still. But in spite of Moorcroft's and Harballabh's experiences being diametrically opposite, both were right. In 1796 there was an effluent which had dried up in 1812. The same phenomenon was reiterated 35 years later on, when Strachey's strong current dried up. And it has again been reiterated, as I shall show hereafter. This periodicity, which may have been going on for thousands of years, and which has nothing to do with the general desiccation of postglacial time, depends simply on the monsoon.

Moorcroft gives another important contribution to the solution of the problem. He says that his own walk, on August 6th, ascertained the fact of the Mansarovar giving rise to no large river. The old Pundit remained much dissatisfied with this decision, and a traveller from Ladak asserted that eight years earlier, or 1804, the stream actually existed, which since that period had dried up, and the bed had filled. Moorcroft explains the change as a cause of an earthquake but the description he gives is in itself much more natural, without any such extraordinary theories.

He gives a very good and detailed description of the lake as he saw it between the Himalaya, »which pours its liquified snow into its basin», the eastern prolongation of the »Cailás ridge» and other mountains. The lake has the form of

an irregular oval, 11 miles from north to south, 15 miles from east to west. The water is »clear and well tasted». Grass is thrown upon its banks from the bottom. Lake Mapang has a noble appearance, whether agitated or quiet. And he finishes his classic monograph with the words: »At what season this large basin is most full, I could not learn; but I apprehend this must be the driest season, as the greatest part of the water-courses which I saw were dry. But I found no appearance of water-mark above four feet higher than the present water line; which would be wholly insufficient to produce any overflow of its banks».

As a matter of fact he visited the lake during the beginning of the wet season. But as most of the rivers he saw were dry, the year must have been exceptionally poor in precipitation.¹

On August 8th Moorcroft and Hearsay began their return journey to the west. They crossed a river running to the Ráwanhrad or Rakas-tal, which had been dry on their way out, but now contained 2 feet of water. They marched a good distance to the north of Rakas-tal and therefore categorically deny the existence of any islands in the lake, which had formerly been reported to exist. The further description of the lake is fairly correct, but the representation on the map is wrong.

He thinks the lake consists of two legs and their divergence forms an angle. As to the issuing river he thinks he saw a stream issue out of it at the western side of this angle, which, as he supposed, communicated with many streams which form the Satlej: but this point he purposed to decide.

Alas! he could not go to the Rakas-tal on account of his fever. But he found out that many rivulets go from the Cailás or Kailas ridge to the lake and wrongly supposes that still more come from the south: he much regretted leaving unsettled the question of a branch of the Satudrá proceeding from the Rakas-tal, but had to bow to the necessity of the case. He heard that the lake was four times as large as the Manasarovar, but could give no opinion of his own. The principal streams which rise in the Kailas, and disemboque, he found to be, 1st, the Siva Gangá; 2nd, Gaurí Gangá; 3rd, Darchan Gadráh; 4th, Cátyáyani.

On August 13th he crosses the rivers going to »the Tirtápuri river». Two of them were crossed on bridges and seem to have been rather swollen as he speaks of one of his yaks swimming over with his load on. Beyond Tirtapuri, on August 15th, he passes the entrance of a large river, supposed to issue from Ráwanhrad, and at the same place another little stream also falls into the Tirtapuri river. »The stream resulting from this junction now takes the name of the Satudrá.» In

¹ In 1907 the difference in height between the surface of the lake and the highest point of the issuing channel's bed was 2,₄₆₃ meter or 7,₄₂ feet. Thus MOORCROFT's four feet prove that the surface anyhow stood much higher in 1812 than in 1907. And we can be absolutely sure that constant oscillations are going on from one year to the other and from one season to the other. In this way the level of the lake must be very sensitive, and it probably changes even from day to day by a fraction of a millimeter.

this he is wrong, as the Tirtapuri river comes from the Rakas-tal, and the other is the Gyanima river. Here his map is also wrong.

His way now goes over Kien-lung, Dúmpú and Daba. Once he heard of the riding post from Gartok to Lhasa or »Ouchong», a distance which he calculates at 880 miles. But we leave his further adventures and narrow escapes on the way back over the Niti pass to India.

His map, Pl. III, forms a highly interesting document, and was, for its time, a great addition to geography. The two lakes are marked between the very regular ranges of Himáchal Mts. and Cailás Mts. running N.W. to S.E.

Mt. Cailása is placed on the map on the range Cailás Mts. After Desideri, Moorcroft was the first European who saw this part of the Transhimalaya.

»Lake Mápáng or Mánas-sarówar» is not far from correct, whereas Ráwan-hrad is very bad. Only its N.E. corner, where his route was nearest, is good. His greatest mistake is to represent the Tirtapuri river as beginning from the plains south of the Kailas Mts., instead of from Rakas-tal and to represent the Gyanima tributary which joins a little below Tirtapuri as being the branch coming from the lake. In 1812 no water could possibly issue from the Rakas-tal, as there was not even a channel between the two lakes. Even when this channel, nowadays occasionally carries water, there is, as a rule, no efflux through the old Satlej-bed. As the natives obviously have told Moorcroft there was really a river going out of the Rakas-tal, this lets us suspect that there was an efflux in 1796 and 1804 and that the natives reported their experiences from then.

RITTER discusses in his usual able and thorough way the results of Moorcroft's journey.¹ From the knowledge of his time Ritter could not know, that all these pretended discoveries were imaginary. For, as we have seen, Moorcroft was not even the first European at the lakes, which had also been so well mapped already a hundred years before his time. And he never visited those parts of the country where the sources of the Satlej and the Indus are situated. But Ritter is right in calling him an audacious and excellent observer, whose journey cleared up many dark points in western Tibet and also regarding the communication between this country and Turkestan. In the discussion he again says that through him the upper and real courses of the Satlej and the Indus were discovered and that »he was the first European who visited and discovered the sacred lakes».

On his road from Gertope to the Manasarovar he passed the sources of the Indus, says Ritter. He also saw and crossed the table-land that is the water-parting between the Indus and the Satlej.²

¹ Will. Moorcroft's Uebersteigung des Niti-Ghat und Entdeckung der heiligen Seen, der Ssetledsch- und Indus-Quellen, und der Umgebungen des Kailas, 1812. Erdkunde von Asien, Band II, p. 504.

² »Aus drei Hauptarmen fliesst dieser merkwürdige Plateaustrom zusammen, der als der wahre Proteus, zu allen jenen Verwirrungen zwischen Ganges und Indus, von jeher, die Veranlassung gegeben, weil er offenbar die geographisch vermittelnde Rolle zwischen beiden spielt.»

The three source-branches which Ritter means are: the northern branch passing Misar, the Tirtapuri branch, and the branch which comes from Rawan-hrad. Otherwise, Ritter seems to leave the hydrographical question open.¹

On his second journey to the interior of unknown Asia, Moorcroft got more reliable information and personal knowledge about the upper Indus. During his residence in Leh he writes: »This was the river of Lé, the Yuma, or Sinh Kha bab, which may be considered as the main branch of the Indus, flowing from the province of Gardokh.»² And at the same time he hoped that the discovery of the source of the Satlej should not be far off, as he says he has obtained news from Mr Gerard of his intention to follow the Satlej, if permitted, to its source, and then return and join him in Ladakh.³ In connection with his rather good general description of Ladak he again says of the Indus: »The river that may be regarded as the most striking and important feature in the geography of Ladakh, is the great eastern branch of the Indus, or, as termed in the country, the Sinh-kha-bab, the river that rises from the lion's mouth, in reference to the Tibetan notion, borrowed perhaps from the Hindus, of the origin of four great rivers from the mouths of as many animals; as the Indus from the lion's mouth; the Ganges, Mab-cha-kha-bab, from that of the peacock; the Satlej, Lang-chin-kha-bab, from that of the elephant; and the Ster-chuk-kha-bab, or river of Tibet, from the mouth of the horse. The Sinh-kha-bab rises in the Kan-re, Kangri or Kantesi mountains, the Kailasa of the Hindus, and after traversing the country of Chan-than in a direction from south-east to north-west, enters Ladakh on its eastern, and follows the same course to its western frontier.»⁴

¹ »Dieser westliche, grossere See, sollte mit dem östlichen, kleinern, dem Mapang, die jetzt beide niedrigen Wasserstand hatten, communiciren. Doch fehlte Moorcroft die Zeit, diese bedeutenden Seen selbst zu umreisen, und hierüber, vollständigen Bericht zu ertheilen . . . As he only touched the northern side of the two lakes, RITTER seems to think it possible that some communication might have existed further south.

² H. H. WILSON's edition of MOORCROFT'S Travels 1819—1825. London 1841. Vol. I, p. 236.

³ Ibidem p. 252.

⁴ Ibidem p. 261.

CHAPTER VIII.

FRASER'S JOURNEY.

JAMES B. FRASER is one of the Britons who at an early date contributed to our knowledge of the mountain barriers between Tibet and India and who went in search of the sources of the great rivers. We are not concerned with the Jumna, but as Fraser also took a good deal of interest in the Satlej he must be mentioned in this historical account.

It may sound as a paradox that he proves the Jumna as originating from a glacier and still he did not know what a glacier was. For he simply calls the glaciers »snow«. He approached the place pointed out as Jumnotri, all around which the snowy peaks were towering above him.¹ The bed of the river was stopped by a prodigious mass of snow which had carried down with it a mighty ruin of rock and soil. From under these »ravines of snow« two rivers flow, one of them, the At'h-paisa Gunga, being equal to the upper Jumna. From here it was not far to Jumnotri. Above and around this place were seen all the numberless ravines, down which all the various sources of this branch of the Jumna trickle.

He describes the hot springs of the place and tells us that the spirits of the twelve Rishis or holy men who followed Maha'deo from Lanca, after the usurpation of the tyrant Ravan, to the Himāla range, inhabit this rock. In a little village only one day's journey from Gangotri he got the information that Chaprang was a large town situated in a plain where there was nothing but short grass and no wool of any sort. The distance to Chaprang was said to be one month to the north, — the ordinary exaggeration. Only one day's march was said to go through snow, the rest over a level plain. On the way the Satlej is crossed on a wooden bridge; »it is even then of considerable size, and it goes under the name of Lang-gin-T'hang; but they know it to be the same stream, which, in Biseher, is called Satudra or Setlej.«

¹ »Account of a Journey to the sources of the Jumna and Bhagirathi Rivers.« Asiatick Researches, Vol. XIII. Calcutta 1820, p. 170 et seq.

Fraser was exceedingly anxious to get information about the Satlej and its sources, and paid particular attention to all the natives said relating to that river. He has some confidence in what they told him, about the river coming from a considerable distance to the eastward and behind the Himalaya range. But the natives could not distinctly say where the river was derived from. His intention was to follow the river up to its very source, but he found that it was too large and rapid. He is of opinion that the Satlej is, in all probability, chiefly supplied by the melting of the great bosom of snow that terminates the valley, and lies between the peaks of the mountains spoken of above. This mountain, reckoned the loftiest and largest of the snowy range in this quarter, and probably yielding to none in the whole Himāla, obtains the name of Rudra Himāla, and is supposed to be the throne or residence of Maha'deo himself. The mountain has five principal peaks forming a semicircular hollow, filled with eternal snow. From this the principal part of the river flows. He is certain that the Satlej comes through the Himalaya and that the Bhágirat'hi rises within the same mountains.

Fraser travelled three years after Moorcroft, and his account was published two years after Moorcroft's in the same journal. Under such conditions it is curious that he does not make any allusion at all to the very valuable and important results of his predecessor. He does not seem to have had any knowledge of Moorcroft's journey, for if he had known of it he would hardly have reported the native information that beyond the Rudra Himalaya, at only 12 *cos'* distance there was a plain and well cultivated country, which was impossible to reach, except by a very circuitous route. But whether they alluded to the great plains of Tartary, or to some intervening valley it was impossible to discover. Moorcroft had heard from the natives that the Satlej issued from the Rakas-tal. But of this there is not a word in Fraser's account.

This omission, however, Fraser made good in his great, and, for the time, very remarkable work containing the results of his journeys and which was published the same year as the above quoted article. Regarding the holy lake and the sources of the Indus and Satlej he there publishes some information he got from a native, and which nearly corresponds with that of Mr Moorcroft.¹ This native said that the holy Lake of Mantullaee, or Mansrowar, is about eight days' journey from Gārā (Gartok). Gārā appears to be situated near the forks of the Sing-kecho, or rather the Eekung, or chief branch of the Attock, where it collects the different streams from the mountains in the vicinity of this great lake, if not from the lake itself. In the Sing-kecho we easily recognise Singi-chu. Concerning this river he says in another place:² Hymāp is on the banks of the great river Sing-kechoo, which, rising in the mountains around, and to the north of lake Mantullaee, runs by Gārā through Lud-

¹ Journal of a Tour through part of the Snowy Range of the Himāla Mountains, and to the Sources of the Rivers Jumna and Ganges. London 1820, p. 289.

² Ibidem p. 285.

hak, by its capital Leh . . . He finds it almost beyond question that the Singkechoo forms a portion of the Indus. Concerning the north-eastern branch, the real Singi-kamba, he did not get any information at all.

Regarding the lake itself he has the following interesting passage:¹

»The lake of Mansrowar, or Mantullaee, we are informed, is of considerable extent. A journey round it, which is reckoned a very necessary religious exercise, occupies from six to eight days on horseback. This is probably a great exaggeration, and certainly, according to Mr Moorcroft's opinion is so. He estimates the lake at sixteen miles long, by eleven broad; but irregularities on the bank, causing the road to retreat from it, may lengthen the journey considerably. Our informant describes the hills around it, however, as consisting more of soil than rock, with little wood, but chiefly covered with grass, and a sort of furze called damak. He also declared that one branch of the Sutlej comes out of the lake; but Mr Moorcroft seems to have ascertained this to be a mistake, and refers the source of this river to Rawenhrudd, a lake in the vicinity. It seems, however, scarcely possible that a lake, which receives from the Himālā so many streams and collects so large a body of water, should have no outlet; and if this is not apparent, we must suppose that there is some subterraneous communication, possibly with Rawenhrudd itself, by which the superfluous waters are carried off.»

Thus Fraser's native informant knew that one branch of the Satlej took its origin from the Manasarovar, though he points out that Moorcroft had found the source of the same river to be in the Rakas-tal. Fraser tries in a most clever way to make these two versions agree with each other in letting the superfluous water of the Manasarovar go down to Rakas-tal, — under ground. For he finds it almost impossible that the Manasarovar should have no outlet.

His informant's Mansur and Dumcho, Fraser identifies with Moorcroft's Misar and Darchan, the latter situated near the 'lofty range of hills' called Kailas Purbut, the streams from which were called Gangree, forming the chief supply of the lake Rawenhrudd.

He seems not to have had sufficient confidence in Moorcroft's observations for he has not made use of them on his own map. Instead of Moorcroft's route he has laid in a native itinerary, which has no value whatever. The Manasarovar he calls »Lake of Mantullaee», in which we recognise d'Anville's Mapama Talai or Lake Mapam. But no river takes its rise from the lake; the Rakas-tal is not entered on the map at all and the whole upper course of the Satlej is left as a blank.

The fable, entertained even in rather recent times, that a plain extended north of the Himalaya, might have found some support in communications such as this: »To Garah (Gartok) from Chaprung is also a month's journey to the northward, through a perfect plain, without wood, covered with small grass.» Regarding the Lang-gin-T'hang or Langchen-kamba, Fraser found that the natives were »quite aware that it is the same river that flows through Bischur under the name of Sutudra or Sutlej . . . They could not say distinctly where its source was».²

¹ Ibidem p. 290.

² Ibidem p. 481.

Comparing the absolute altitude of the Satlej with that of the Bhagirathi, Fraser comes to some interesting conclusions about the ultimate source of the Ganges and the breadth of the Himalayan system:¹ 'The Sutlej certainly comes through the snowy hills; and it must be allowed that the difference of altitude, which these circumstances indicate, proves that the Bhagiruttee cannot do so, its course even at this point being so very elevated. If it does not come through the Himālā, its source cannot be far from hence (Gangotri). He gives the mountainous region a breadth of 60 to 80 miles at most. He places the Roodroo Himālā at the centre of the snowy range and supposes that the mountainous land rather falls than rises to the north and N.E. of this mountain.

¹ Ibidem p. 471.

CHAPTER IX.

THE BROTHERS GERARD.

From 1817 to 1829 the brothers GERARD made several journeys in the western Himalayas and contributed considerably to our knowledge of these regions. Almost all their work lies outside the limits of that part of Tibet we are discussing here, but they have gathered a good deal of interesting information about the two lakes and the sources of the rivers. Ritter is right in giving them the highest praise for the valuable results they brought home.¹ From their narratives I will only take out such parts as may be of interest to us.

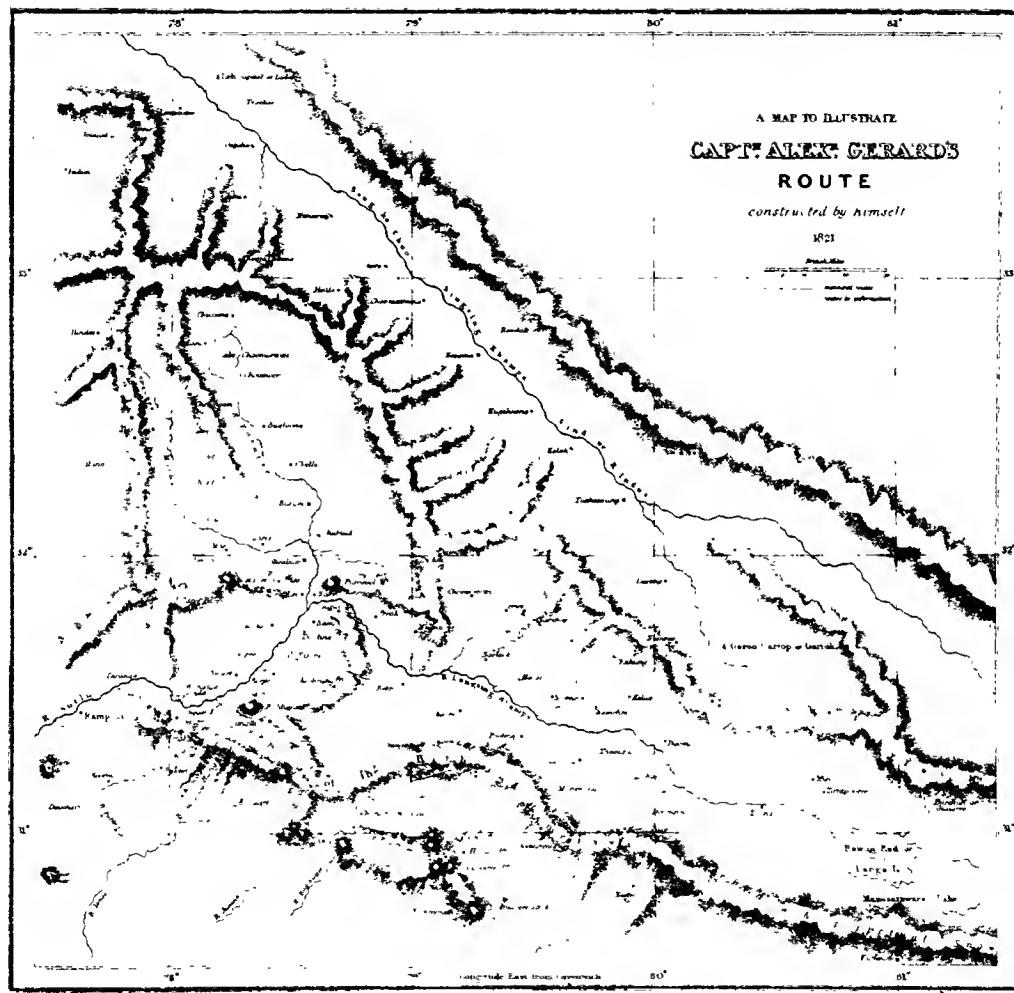
Most important are the reports of Captain ALEXANDER GERARD, who, in his journey of 1817, was accompanied by Dr. GOVAN, and in 1818 by his brother, Dr. J. G. GERARD. The diaries of these journeys have been published by GEORGE LLOYD.² Here the journal of 1817 has been compiled from Gerard's route book. The diary from 1818 he had written himself. The map was reduced from Gerard's original maps. The editor is no doubt right in calling him one of the most enterprising of British travellers, a man of indefatigable zeal.

Alex. Gerard very well knew the existence of the range situated on the right bank of the upper Indus, which was already known to Moorcroft. Native travellers had described this range to him, but he had never fallen in with anybody who had crossed it in a north-easterly direction. From the Keobrun pass he got a view of the range that runs along the left bank of the Eekung choo or Garoo branch of the Indus and which he regarded as a continuation of the above-mentioned one. He could see the part of it where Moorcroft passed on his way from Daba to Gartok. He was informed that a projection of this range, which is crossed again between Garoo and Mansurowur, forms the Kailas or »Kangree» mountain, situated north of the sacred lake.

He confesses that the extraordinary orographical arrangement he gives to this part of western Tibet is only conjectural. Thus he believes there is a great central

¹ Die Erdkunde von Asien, Bd II p. 546.

² Account of Koonawur in the Himalaya etc. London 1841.



Captain Alexander Gerard's map of 1821.

chain, most probably extending from N.E. to S.W. and that all the high mountain ridges which he has seen with his own eyes stretching N.W. to S.E. are only subordinate ranges shooting out from this central chain. His reason for supposing such a central chain is that the Kailas or a continuation of it throws off the waters of the two largest rivers in India in opposite directions, the Indus to the N.W., and the Brahmaputra to the S.E. Such a place, he thinks, must be the most elevated land, unless one should suppose the Kailas range to be lower than the ridges that branch off from it. He heard that people constantly travelled from the sources of the Indus and the Brahmaputra to Ladak and Tashi-lunpo but he never met anybody who had been beyond the Kailas, but several who had made the circuit of it. And he adds; »so we shall probably remain long in the dark respecting the country that lies to the N.E. of Mansuowar». And he was right in this supposition!

As to the Satlej he says that its chief branch, or that which has the longest course, issues from Rawun Rudd Lake, or Langa-Cho, and about the Indus that geographers are indebted to Lieutenant MCCARTNEY (Macartney) for putting it right for us. For Macartney ascertained that the Indus ran past the capital of Ludak, and Roodok, a place of some note, famed for its lakes of salt and borax, half way between Leh and Garoo». It is strange that he could accept such erroneous information, remembering that the Lamas had placed Rudok correctly already a hundred years earlier. Otherwise his inquiries gave the same result as Moorcroft's exploration. Thus he found that the river issuing from Rakas-tal was indeed the Satlej, and the river passing Gartok, and which was called Eekung-Choo, was a branch of the Indus.

In speaking of the origin of the Satlej, Captain Gerard refers to Major Rennell, whose Lanktschou, or Langchoo, for the upper Satlej, is the same as the Langzhing-Choo or Langzhing-Khampa, as the river is called in Chinese Tartary (Pl. IV). He could not ascertain the meaning of 'zhing' but it appeared to have nothing to do with the name of the river, for the Indus he found named Singe-Choo, or Singzhing-Choo, as well as Singzhing-Khampa, the last word meaning river.¹ He thinks, with Rennell that if the latitudes and names of rivers as given by the surveying Lamas had been accepted, the maps of India would have been much more correct than they were. Some degree of dependence might still have been placed on the authority of the natives, especially as they insisted that the Ganges issued from the S.W. foot of the Himalaya, and that the river from the Manasarovar was a different one, and called Langchoo, or Satlej, which was represented as having a very long course, as is actually the case. Captain Gerard met more than one hundred people who had travelled up the Satlej, not exactly to its source, but to within ten or twelve miles of it to the place whence the road turns off to the Manasarovar. »All the accounts agree that the largest stream issues from the western corner of Rawun Rudd,

¹ Op. cit. p. 24. The real name is Langchen-kamba.

or Langa, and even close to that lake, it is stated to be thirty feet broad and one-and-a-quarter deep, in the dry season, and very rapid.»

As so many natives told him the same story about the river issuing from the lake one can hardly doubt that this was really the case in 1817 and 1818. The fact that the river, close to the lake, was 30 feet broad is, however, no proof, as this water may be carried down by one of the tributaries. But as the river is positively said to come out from Langak-tso, there seems to have been a gradual rise from 1812 to 1818.

Gerard goes on to say that already at »Thooling or Ling» the river is so broad that an iron chain bridge must be used. He found out that in »Chinese Tartary» the river was called Langzhing-Khampa for 200 miles, after which it is called Muksung and lower down Sampoo, Sangpoo, Sanpo or Zung-Tee. Still lower down, in Koonawur, it is called Sumudrung or the river. Near the capital of Busehur he found the name to be Sutroodra or Sutoodra, and finally Sutlej. The natives of Koonawur were found to use the names Sutlej and Sutoodra even up to its source.¹

Gerard wished to proceed to the Manasarovar, but was stopped on the frontier by the Chinese. Orders had been issued from Lhasa that no Europeans should be admitted and in case they did not obey they would not be supplied with provisions. Even two pilgrims on their way to the sacred lake were stopped at Shipki as they were taken for Europeans in disguise. But Gerard found the natives communicative enough and was enabled to verify the accounts of the Manasarovar and the great rivers which he found to agree minutely.

Thus he was told it was an obligatory duty of the Lamas to perform the circuit of Mapang and Kangree or Kailas, the oftener the better. Some people used to walk round both lake and mountain once every year. The most religious used to walk round the lake seven times, which is a sacred number. The Manasarovar, called by the »Tartars» Mapang-Cho, is situated in a very bleak place, surrounded by arid gravelly mountains. There is parched grass and *furze* in the vicinity, but no wood; turf extends to the borders of the lake, and there are neither marshy grounds nor swamps. Its height he regards as a *desideratum*.

Gerard tried to get the altitude of the lake by the method of calculating the fall of the Satlej compared with the distance between known points. He arrives at 17,000 feet which he thinks may be rather too low than too high. And he supposes the Rakas-tal to be 200 feet lower than the Manasarovar, so much more »since a communication formerly existed between the two lakes». He knows there are Lamas and nuns living in houses all round the lake the whole year and finds it most likely to be the highest inhabited land on the face of the whole globe. The

¹ In 1821 Captain A. Gerard and Dr. J. G. Gerard made an important survey in the valley of the Setlej. »On the Valley of the Setlej River, in the Himalaya Mountains, from the Journal of Captain A. Gerard, with Remarks by Henry Thomas Colebrooke, Esq. Dir. R. A. S.» Transactions of the Royal Asiatic Society of Great Britain and Ireland. Vol. I. London 1827, p. 343 et seq.

considerable elevation he finds probable from the circumstance of four of the longest rivers in India taking their rise in that quarter.

These four rivers are: the Satlej, the Indus, the Brahmaputra and the Gogra. The Sind or Indus is called Singe Choo or Singzhing-Khampa and has its source to the northward of the Kylas Mountain, and some of its fountains come from the foot of it». The first part of this sentence contains the truth about the source of the Indus. Gerard also heard of one of the tributaries which he thinks must be the same as the Shayook of Lieutenant Macartney, which was said to run west of the road between Leh and Yarkand.

The third river was said to be larger than the Indus, and called Tamjoo, Damchoo, or Erechumboo; ¹ that is, the Brahmapootra. »One stream, which is reckoned the principal, rises south-east of Mansurowur, and there are others from the eastward; this agrees very well with the accounts of the Lamas, who describe the Brahmapootra as issuing from the eastern side of Mont Kentaise, undoubtedly a topographical error for Kenlaise (Kylas), which those people must have well known, since it is the duty of Lamas to perform the circuit of that mountain.² They make the Brahmapootra rise south-east of Conghe Lake, which the Koonawurees call Koon-geoo or Goongeoo; there must, however, be many heads to this river; so I look upon the accounts of the Lamas as pretty correct.

He is perfectly right in saying the principal stream of the Tamchok-kamba is situated S.E. of the Manasarovar. In improving Kentaise to Kenlaise or Kailas he is less fortunate. Other views of Gerard regarding the source of the Brahmaputra we will consider in connection with the history of the knowledge of the upper Tsangpo.

The fourth river is the Gogra or Soorjoo. He quotes Tieffenthaler's belief of its beginning from Lanka Dhe, but adds that the Father did not visit the upper part of the river personally.

He also heard some vague reports of a fifth large river, said to flow to the N.E. some 12 days east or E.N.E. of Gartok. This he thinks may be the Yangtse-chiang and finds it probable that this river rises from the snow and not from the sandy desert far to the east. If it came from the neighbourhood of the Manasarovar he thinks it would be little less than the Amazonas! So little was known of the interior of Tibet in his days.

The sacred lake itself had, however, the greatest attraction for him. He heard it was four days or 50 miles in circumference and thinks Putee Ram's estimate in Fraser's book, where it is made 6 or 8 days round, must be exaggerated. He rather depends upon the accounts he received from some Lamas. And he argues with Fraser who prefers Putee Ram to Captain Hearsay.

Gerard was told there was plenty of fish in the Manasarovar which is sacred and not eaten, whereas the natives eat the fish of Rakas-tal. There was a great

¹ Yeru-tsangpo.

² The Lamas do not know this name. They call the mountain, Kang-rinpoche.

number of wild-fowl. He gathered all information he could get of the freezing and breaking up of the Manasarovar. The winter was said to be very severe. The amount of snow is not great, seldom one foot deep and the snow is powdery. During the cold season the lake is at its lowest level, as no streams flow into it then, and it is highest in June and July, when the snow melts.

To Moorcroft's assertion that there was no outlet from the lake, although he heard there had formerly existed a communication between the Mapang and Lanka, Gerard adds¹ that the Manasarovar has always been reckoned by the Hindus to be the source of the Sutlej, «although European geographers were of a different opinion». Captain Webb believed that there was a considerable difference of level between the two lakes, and that the superfluous water of the Manasarovar was drained off by a subterraneous passage, and Gerard thought he was right.

As to the Pundit and Ladakis who positively asserted to Moorcroft that they had seen the outlet, Gerard does not see the slightest reason to disbelieve them and he wonders why Moorcroft did not set the matter at rest by sending for and inquiring of the inhabitants.

For his own part he says: »My information is positive, that about 20 years ago, a stream, which was rapid, and crossed by bridges, ran from it (Manasarovar) into Rawun Rudd, but it has since dried up, and the Lamas who reside on the banks, have an idea that a subterranean communication exists.» If his information is as true as it is positive there should thus have been a channel in 1800. The natives, both Chinese, Tibetan and Hindu, still believe in subterranean communications round the lakes. Webb had been told of a hundred streams entering the Mapang and only one going out of the lake. Colebrooke had concluded that, in so cold a climate the evaporation could not be equivalent to the influx of water in the thawing season. Gerard himself is persuaded that, as lakes without an outlet must be salt, there was probably some drain for the waters of Mapang, either above or under ground, for, from its being surrounded by stupendous mountains, it must receive nearly as many rivulets as Rawun Rudd, and the stream that issues from this last lake is very considerable in the hot weather; besides, one of the rivers that run into Manasarovar, is stated to be of some size. This the people call the Sutluj, the most remote source of which is said to be at a place named Chomik Tingdol, where a small stream gushes rapidly out of the ground with a rumbling noise: the length of this river is reckoned about 40 miles, and it passes through, or rather by expanding, forms Goongeoo Lake, the Conghe of the Lamas. Goongeoo is called fifteen or 20 miles long by the course of the river, but very narrow.»

Gerard has got a really scientific grasp of the problem. The Manasarovar is fresh so it must have an outlet. Both lakes receive many rivulets and so it is no wonder that a considerable river goes out from the western lake. But when he

¹ Op. cit. p. 138.

talks of a river of some size entering the Manasarovar, called by the natives Satlej, and coming from the Chomik Tingdol, and at the same time says that this river forms the Gunchu-tso, he confounds two rivers, namely, the Tage-tsangpo, which is the one called Satlej by the natives, and the Samo-tsangpo, which is the one coming — not from Gunchu-tso, but at least from its neighbourhood.¹ So when it has been pretended that Gerard's opinion should have been that the source of the Satlej should be equivalent to the source of the river which falls into the Gunchu-tso and continues from there under the name of Samo-tsangpo to the Manasarovar, such a pretension has no foundation whatever.²

Major RYDER gives the following description of Gunchu-tso: »... a lake 11 miles long by 2 or 3 miles broad, with an area of 22 square miles, completely frozen over, and having no outlet at all.»³

Captain RAWLING says: »Gün-chu Tso has obviously diminished in size within comparatively recent years, for about ten square miles of excellent grazing ground lies at the eastern end. This area is almost flush with the level of the water, and in summer forms a dangerous quagmire. . . . Gün-chu Tso, along the shores of which we travelled, was entirely frozen over, and the ice of sufficient thickness to bear laden animals; this surprised us, for the Tibetans stated that the waters were bitterly salt, and this is more than probable, as there is no outlet. During the summer rains, and when the snows are melting, the lake steadily rises, but never to a sufficient height to drain into any other lake system.»⁴

HERMANN VON SCHLAGINTWEIT pays due attention to the fact that Gunchu-tso is a salt-water lake.⁵

To recapitulate: the problem whether the Gunchu-tso belongs to the drainage of the Satlej or not, has the following situation. The river which the natives call the uppermost Satlej was misunderstood by Gerard as coming out from the Gunchu-tso. This mistake has been used to prove that the source of the Satlej 90 years ago was situated between Gunchu-tso and Maryum-la. But Gerard did not

¹ Gerard's Chomik Tingdol, or »Spring of Tingdol», is obviously the sacred spring Langchen-kamba, which I visited on the Tage-tsangpo in 1907. »Trans-Himalaya», Vol. II, p. 105. Langchen-kamba is the Tibetan name for Satlej. As Gerard says the river coming from Chomik Tingdol is called Satlej, it is proved beyond doubt that he means the Tage-tsangpo. That he confounds the two affluents is far from surprising, as no European had ever been in the region.

² Geographical Journal, April 1909, p. 427. »The source of the Satlej was formerly that stream which enters the Gunchu Tso on the west side of the Maryum-la. It is interesting to recall that Alexander Gerard placed it there ninety years ago. This lake formerly discharged into the Tokchen river, and so reached Mansarovar.»

³ Geographical Journal, October 1905. Vol. XXVI, p. 387.

⁴ The Great Plateau, London 1905, p. 244.

⁵ »Von ähnlich gelegenen Seen des centralen Tibet sind der See Kongkyú in der Nähe des 15,500 F. hoch gelegenen Maryim La-Passes und die schon länger bekannten grösseren Seen Mansaráuer und Rákus Tal, Höhe 15,250 F., noch anzuführen. Nur der erstere ist ein Salzsee; die beiden letzteren, die man früher ebenfalls für solche hielt, haben sich als Süßwasser ergeben.» — Untersuchungen über die Salzseen im westlichen Tibet und in Turkistan. Von Hermann Schlagintweit-Sakunlunski, München 1871, p. 1.

know that the lake was salt. He knew that every lake without an outlet must be salt. If he had known the salinity of the lake he would never have accepted an outlet above or under ground from Gunchu to the Manasarovar. The premisses were quite different after Ryder and Rawling had visited the place and found that the water was salt and never drains into any other lake system. The thick ice covering the lake does not prove anything against the salinity, for Ngangtse-tso in the province of Naktsang is also salt and every winter covered with very thick ice. As all other salt lakes in Tibet the Gunchu-tso also diminishes in size. It cannot either be supposed that the Gunchu-tso in 1818 was really in communication with the Manasarovar and therefore fresh. For, as will be proved by this discussion, there is no indication of a great and decisive desiccation in the last 100 years. There is only a periodical fluctuation. But even in unusually wet years the Gunchu-tso has not drained to the Manasarovar, for if it had, the lake would not be salt. The period is too short to permit the lake to become salt during the depressions, and fresh during the wet years. I mentioned above the Chinese narrative which 150 years ago gave the same description of the Gunchu-tso as Gerard and expressed the opinion that if, as the Chinese text puts it, the lake has a subterranean outlet, it could not be salt. Anyhow, the problem can hardly be definitely solved without a detailed examination of the ground, the beach-lines and the threshold which now forms a western boundary to the lake. My own opinion is that the Gunchu-tso, if really salt as Rawling says, cannot possibly have belonged to the Satlej system for a very considerable space of time.

The question whether the problematic river from Gunchu-tso or the Tagetsangpo should be regarded as the uppermost Satlej, has, however, nothing to do with the drainage of the Gunchu-tso. We have to deal with the problem as it is and not as it may possibly have been in prehistoric times. We have to use reliable observation and avoid uncertain information and hypotheses. In 1907 the Tagetsangpo was several times bigger than the Samo-tsangpo. If, in 1818, the precipitation was much richer than in 1907 the proportion should have been the same between the two rivers. Even if the drainage area of the Samo-tsangpo had been augmented by the area of Gunchu-tso, the addition in water from that lake can not have been considerable, — if it has ever taken place.

When Gerard thinks it is difficult to account for the rise and fall of the lake Manasarovar without supposing an outlet, he forgets that the rise and fall is much more considerable in self-contained basins than in lakes where the level is always regulated by the issuing stream.

For the Kailas he has heard the names Kylas, Kengree or Gangree; the Tibetans call it Heoonlas(?) or Kangree. He finds it strange that Moorcroft has so little to say about the mountain. But Captain Hearsay, in a sketch which Gerard saw, represented it as ending in a very acute point, and being far elevated above the other mountains.

Gerard correctly supposes that Moorcroft exaggerates the dimensions of Rawun Rudd or Langa-cho in making it four times as big as Tso-mavang. The most accounts he got made the lake 6 days in circumference and only one made it 7 days. He only met 6 or 8 persons who had gone round it. On account of its irregular shores he does not think it is much larger than the sacred lake. He criticises Moorcroft who doubted the existence of islands. At least 15 persons told him there was a small island, only 200 or 250 yards across. As a matter of fact Moorcroft says that the lake is »surrounding some large portions of rock a little detached from the Himachul», though at another place he denies the existence of islands.

For Gartok he gives several names: Garoo, Gartop, Gur, Yoogar, Zhoogar and Gurtokh. Tsaparang or Chaprang he calls Chubrang and says it is a collection of tents, inhabited during the winter. Roodak is a town of 200 houses on the right bank of the Indus, half way between Leh and Gartok. It is famed for the salt and borax lakes in the vicinity. Chakchaka is one of them. Ladak is bounded on the north by Yarkund and its dependencies, on the east and S.E. by Chinese Tartary. By Tibet he obviously means only the country farther east, Tibet Proper. Intra-Himalayan regions is an expression he is probably the first to use.

On Gerard's map,¹ Pl. IV., there is no communication whatever between the two lakes. The outlines of the lakes are somewhat changed from Moorcroft's representation, and in the centre of Langa Lake there is an island. The Satlej issues from the Langa Lake. The N.E. branch of the Indus is much greater than the Gartok branch.

Dr J. G. GERARD has written an article: *Observations on the Spiti Valley and circumjacent country within the Himalaya*, which proves that its author was far ahead of his time.² It was published the same year as Ritter's second volume of his geography of Asia and gives a good general idea of the then current views of some parts north of the Himalayas. He says nothing is known or even conjectured about a northern and N.E. boundary of the great central platform of Asia. He regards Lake Mánasarovara as the highest point of the Indian Peninsula, forming a plain which throws off the great rivers from S.E. to N.W., and the base of clusters of peaks insulated between their sources and the northern slope of the plateau, of which all knowledge was still confined to conclusions from the upper course of the Satlej and Indus, where the basins of those rivers, and consequently the lowest depression of the soil, had been ascertained to rest upon the zone of 15,000 feet, and the table land, through which they flow, to rise beyond 17,000. »There are but approximations to the altitude of the broken plains of Tartary, which only serve

¹ Vide: Narrative of a Journey etc. by Sir W. Lloyd and Captain Alexander Gerard's account of an attempt to penetrate by Bekhur to Garoo, and the lake Manasarowara. Vol. II. London 1840.

² Asiat. Researches, Part II, Vol. XVIII. Calcutta 1833, p. 238 et seq.

to prolong conjecture as to the extreme verge of the highest lines of level. All the waters from the northward deflexure of this mass of mountains from the great Kylás chain and table land on both sides of it, running into the grand rivers, which form the Peninsula of India, or intersect the Gangetic plain, or tending towards an aspect comprehended between the debouchures of the Brahmaputra and Oxus.¹

He regards the Satlej as the centre of this system of rivers. On its course downwards from the Manasarovar, the Satlej collects tributaries from the northern side of the Himalayas as well as from the high table land farther north. He imagines that this table land rises in bluff undulations, terminating in a rival crest, Kailas, which sends its waters to the Indus. The interior of high Tibet was in his days so little known, that he believed the whole country inhabited by »Tibetan Tartars» grazing their sheep the whole way between Yarkand and Lhasa.

He makes the Manasarovar 17,000 feet high, for Moorcroft had snowfall at midsummer and so had Csoma de Körös in Sanskar on the day of the summer solstice and in the beginning of September. At the lake itself Moorcroft had several inches of snow on 10th August. Comparing these facts with analogous observations in Rupshu he cannot give the lake less than 17,000 feet, although European theorists estimated the table land of Tibet at 8,000 feet above the sea.

He expresses his views on the evaporation thus:¹

»To this accelerated vaporization is owing the fluctuation in level of the lakes in Tary, in defiance of increasing cold. The lake of Mánsarovara celebrated in Hindu mythology for giving efflux to several rivers in opposite directions, (a metaphorical figure to indicate the point of their divergence) was not admitted, upon Moorcroft's assertion, to be land-locked, from ideas of the feebleness of evaporation at that great height then unknown and unsuspected; and though the lake does appear to have an outlet in the Satlej, this does not alter the question in regard to basins (inferior it is true to Mánsarovara, but under similar circumstances) having been found wholly inclosed; and Moorcroft was right as to the fact, though his reviewers could not reconcile it with their preconceived opinions.»

As a matter of fact it would be much simpler to say that if the evaporation alone balanced the level of the lake, the water would have become salt. But in certain years the precipitation is so considerable that the evaporation is not sufficient to keep down the level, and the surplus of the water goes out to Rakas-tal.

As to the supposition of any other river, except the Satlej, issuing from the Manasarovar, he is right in saying that this is a physical impossibility.²

¹ Loc. cit. p. 259.

² Lassen has extracted the following views from Gerard's information (*Indische Alterthumskunde*, I, p. 43): »Ausser der Sarajû und dem Sindhu, welcher hier Sind, Sing-keku und Singke-Kampa genannt wird und im NO des Mânsa-Sees seine Quelle hat, entspringt im Gebirge im O der nach O strömende Tamgu-Kampa und im S des Sees der Manga-Ku oder Kampa, welcher ebenfalls nach O fliesst; beide sind ohne Zweifel zwei Hauptarme des Brahmaputra. Von einem Reisenden, dem er glaubte Glauben schenken zu dürfen, wurde ihm berichtet, dass 8 oder 10 Märsche im O. Garo's (Gertope's) an dem westlichen der zwei Arme des Indus ein in der Nähe des Sees entspringender Fluss NO ströme. Dieser wird aber nicht, wie er vermutet, einer der grossen Chinesischen Flüsse sein, sondern der östliche Indusarm.»

Finally he remarks that beyond the »great Kylas or Laochi chain, washed in its northward base by the Indus», all our knowledge ceases. But from information and conclusions he is pretty sure of the existence of »still loftier ranges, the nature and limits of which we cannot even conjecture». He also concludes that on these northern ranges the eternal snow must be repelled to incredible height as the precipitation must be minimal from skies almost bare of clouds, a supposition in which he is right only to a certain extent.¹

¹ In a letter dated Sabathú January 21, 1829. Dr Gerard makes the following short reference to the Manasarovar: »Lake Mansarovur has always been considered by Eastern geographers as the central source of the great rivers of India, Brahmapootra, Gogra, Satilej, and Indus, and the highest table-level there, because the waters are thrown off in every direction from that point; but our over-scrupulous exactitude, in literally deriving those rivers from the same lake because the Hindoos had assigned a common origin to them, has led us to tax their ancient traditions with vagueness, incorrectness, and falsehood. Mansarovur being the reputed or even veritable source of these rivers, was a mere figurative position: it was also celebrated on account of Kylas, the throne of Mahadeo, which spires up from that lofty base in the form of a cone, sheeted in snow, and is, without a doubt, the highest point of the earth's surface. The Hindoos knew as well as we did, that two rivers in so rugged a country could not flow out of the same lake in opposite directions, but there is no question about the proximate conjunction of the whole four. We have yet to learn the Tibetan accounts, and as they promise to be free of much of the theological tincture of the Hindoos, we have still before us an unexplored field of interesting prospects.» THEODORE DUKA: »Life and Works of Alexander Csoma de Koros», London 1885, p. 91.

CHAPTER X.

J. D. HERBERT.

We now come to the article by Captain J. D. HERBERT: *An account of a Tour made to lay down the Course and Levels of the River Setlej or Satúdrá, as far as tracable within the limits of the British authority, performed in 1819.*¹ In this able account of one of the great Himalayan pioneers, we find some passages and views about the origin of the great river. Herbert, who travelled in company with Patrick Gerard, could not, however, contribute any new knowledge founded on autoptic observation, for already at Shipki, the first village of Chinese Tartary, he was compelled to retrace his steps.

As to the source of the Satlej he says:

»The Setlej has been lately known to derive its source, if not from the lake Ráwan Hrad, or the neighbouring one of Mansarovar, from the high ground on which they are situated. From the source however, which by Capt. Hearsay's map, is in $31^{\circ} 46'$ Lat., $80^{\circ} 43'$ Long. to Ropur in $30^{\circ} 58'$ and $76^{\circ} 31'$ a distance of upwards of 400 miles, little was known concerning it, or the country it flows through, till the expulsion of the Gorkhas gave facilities to research which had before been wanting: the existence of a Western Branch of this great river beyond the snowy chain was not even suspected, and to our ignorance of this fact may be attributed some errors which could be pointed out in maps very recently published. Of the actual direction of its course an equal ignorance prevailed, or it could never have been made a question, whether the Bhagirathí had its source within or beyond the snowy chain.»

The headman of Dabling, a Lama, gave him some information. He reckoned 5 days on horseback to Cháprang. Even there the Satlej was said not to be fordable. The Kanáwari's called the river Zangtí, the Tartars Lang Jing Kunpa or Kumpa. The Manasarovar was said to be 18 days' journey from Shipki. The Lama told him the Mapang was either seven or four days' journey in circumference according to the season, which indeed must have given Herbert a rather absurd idea of the lake, unless the Lama really meant walking or riding, for as we know, the influence of the seasons upon the circumference of the lake is negligible.

¹ Asiatic Researches, Vol. XV. Calcutta 1825, p. 339 et seq.

The same Lama told him the old story of the four rivers originating from the lake. He called them: Tamja Kampa flowing through Ussang (=Utsang); Mamja Kampa through Púrang; Lang Jing Kampa through Kanáwer; and Sing Jing Kampa through Ladak. The Lama had seen them repeatedly and said that they proceeded from the four opposite corners of the lake. Herbert finds this assertion completely contradicted by Mr. Moorcroft's journey, and thinks the whole story is some legend from their sacred books. »There is a second lake, close to Mapang called Langa Cho; it is smaller, but in the rainy season they unite and form but one.» The Lama stated that the Satlej began from Manasarovar and flows through the small lake.¹

Herbert seems to have taken great interest in the celebrated hydrographic problem, for, in an appendix he returns once more and in a somewhat different way to the statements of the Lama of Dabling.² There he gives the names Mápang and Langkachu and reiterates the tale of their communication during the rains.

The statements of the Lama were given in 1819 but it is not said from which year he had got his experiences of the place. It may have been from the last rainy season before Herbert's visit. Very likely there has been a gradual rise from 1812 to 1818, as concluded above, and in 1818 the precipitation seems to have been sufficient to cause the Manasarovar to overflow. Otherwise the Lama could hardly have pretended that the lakes communicate during the rainy season, although his information loses very much of its value when he adds that the three other rivers as well originate from the lake.

In Shipki Herbert met a »Tartar Beapári«, CHANG RING JING from the village of Maryúm, four days' journey beyond the Manasarovar. This man said that the Mansarovar was a snowy range and the lake was called Matalae, which Herbert thinks is a mistake, as Sarowar signifies the same as Talae. Herbert believes that this confusion of names may have given rise to the story of the Dabling Lama of the four rivers originating from the Manasarovar. The Maryum native who had lived so near the place in question, had the following, more correct view: 'no river originates in the lake, but from Mansarovar, which he calls a cluster of snowy peaks, four rivers proceed: 1. Lang Jing to west and south; 2. Tamjok to the west and north; 3. Sing Jing to Ladak between the two preceding; and Mamjo or Mamjok opposite the preceeding towards Gerhwal».

When this informant says no river at all originates from the lake, his statement is exactly the reverse of the Lama's and may be derived from another year. But his information about the Mount Manasarovar and the Tsangpo going west-

¹ On a »Geological Map of the Mountain Provinces between the Rivers Sutluj and Kalee by Captain J. D. Herbert, 1826«, the Lake Munsuvara has no affluents and no effluent. To Lake Rahwun Rhud three rivers go down from Kylas Mountains, and from the same lake the upper Satlej takes its rise. Journal Asiatic Society of Bengal, Vol. XIII, I, 1844, illustrating a paper in Vol. XI, 1842.

² Loc. cit. p. 424.

wards is so absurd, that we cannot take him seriously regarding the Satlej either. In the appendix¹ Herbert returns again to the Maryuni man, but here he calls the lake not Matalae but Mantalai reminding one of d'Anville's Mapama Talai.

Herbert himself seems to regard Kangri »or rather Gangri» as the peak from which the four rivers rise. He heard it was 8 days' journey from Garu (Gartok) to the Manasarovar. Maryum was said to be a village of 8 or 9 houses.² From Maryum to Sambhunáth was 2 months' journey, the first half of the road along a plain, the last half mountainous; several high ranges were to be crossed, and, descending from Tage-la the first village in Nepal, is Kerung (Kirong). The first half of this road seems to be along the Tsangpo. The Tage-la has, of course, nothing to do with the Tage-tsangpo.³

¹ Loc. cit. p. 425.

² Should obviously be tents.

³ The French traveller, VICTOR JACQUEMONT, who made a very important journey in India and the western Himalaya, 1828—1832, has no high opinion of the attempts of the Gerards and Herbert to explain the physical geography of the western Himalaya. Referring to the source of the Satlej he says: «Toute fois, de l'inspection des cartes et de la lecture de leurs (Gerhard, Herbert) mémoires, il me semble résulter, qu'après avoir pris sa source dans le lac d'Harad, ou dans son voisinage immédiat, le Setludje coule au nord de la chaîne des montagnes couvertes de neiges éternelles, dont les eaux se versent au sud dans les affluents du Gange, et qu'il passe du nord de cette chaîne au sud par une large ouverture, par une dépression très-profonde, entre Rampour et le pays de Kanawer.» Voyage dans l'Inde, par Victor Jacquemont pendant les années 1828 à 1832, Vol. II, Paris 1841, p. 191. Rawan-Harad: Hari-hrad is, in the Skanda Purana, regarded as one of the five lakes west of Mandákini.

J. BLUMENTHAL has drawn the map, »Carte de l'Inde», illustrating his journey; here Himalaya is shown as one single narrow range. The Manasarovar is called Lac Mantalaï and has no communication with the Rakas-tal; the latter, which has got no name, gives rise to the Satlej. The source of the Indus is N. W. of Rakas-tal; the Tsangpo has two source branches, the one N. E., the other S. E. of the Manasarovar.

In a letter from Tashigang, dated August 24th, 1830, Jacquemont has a more correct view of the source of the Satlej, but a strange one about the origin of the two other rivers: »Tous deux (Indus et Satlej) ici ne sont que de larges torrens, étant très-près de leur source. Le Sutledge s'échappe du célèbre lac Mansarower, et l'Indus, ainsi que le Barrampooter, qui sont les deux plus grandes rivières de son voisinage immédiat.» Correspondance de Victor Jacquemont ... pendant son voyage dans l'Inde (1828—1832), Vol. I, Paris 1833, p. 243.

On the map accompanying the correspondence the Himalaya is represented as a double range and the lakes are called Lac Rahwun-Rhud and Lac Mansarowar.

CHAPTER XI.

FRANCIS HAMILTON.

FRANCIS HAMILTON accomplished his journey in 1814, but as his account was not published until 1819 and he refers to some of the travellers mentioned in the preceding chapters, I quote him here.¹ In the introduction to his work, Hamilton gives his sources and mentions some native maps.

In the rainy season of 1814 he proceeded up the Ganges with the intention of going to Hardwar, where he expected to procure intelligence concerning the parts west of the river Kali. At Futtuhgur he met with HARIBALLABH, a Brahman, born in Kumau (Kumaun), who had travelled much in the adjacent parts. He does not say whether this Hariballabh is the same as Moorcroft's old Pundit, Harballabh, which, however, seems very likely. With the assistance of a certain Kamal Lochan, Hariballabh had composed a map of the western parts of the dominions of the Gorkhas, a map which later on came into the Company's library. From the same person, Hamilton got another map explaining the country, which extends some way west from the Sutlej. Thus it is from Hariballabh and not from Moorcroft, whom he does not even mention, that he has got his information about the lakes.

He says:² »Near Taklakot, between two parallel ridges of Emodus covered with everlasting snow, Hariballabh places two lakes Manasa Sarowar and Ravanhrad, which receives the water flowing from the former. On their west side is a vast peak named Kailasa . . . He gives a description of the valley in which the lakes are situated, and continues: A river flows from each end of the Ravanhrad, or rather from each lake. That going to the west is called the Satudra and Satrudra, and turning to the south forms what we call the Sutlej. It must, however, be observed, that, according to Hariballabh, there rises from the northern ridge of that eastern part of the valley another river, which, as in the Chinese map of Tibet published in Du Halde, runs west parallel to the Satrudra. Hariballabh does not know its name. It was called to him the river of Ladak, as passing that city. From many

¹ An account of the Kingdom of Nepal. Edinburgh 1819.

² Op. cit. p. 288.

other persons I have learned, that this river of Ladak passes north from Kasmira; and, if not the chief branch, is at least one of the greatest of those which form the Indus. The river that flows to the east from the lakes is named the Karanali, and, according to Hariballabh, who has seen this part of its course, after flowing a short way in that direction, passes through the southern ridge of snowy mountains and waters Yumila.¹

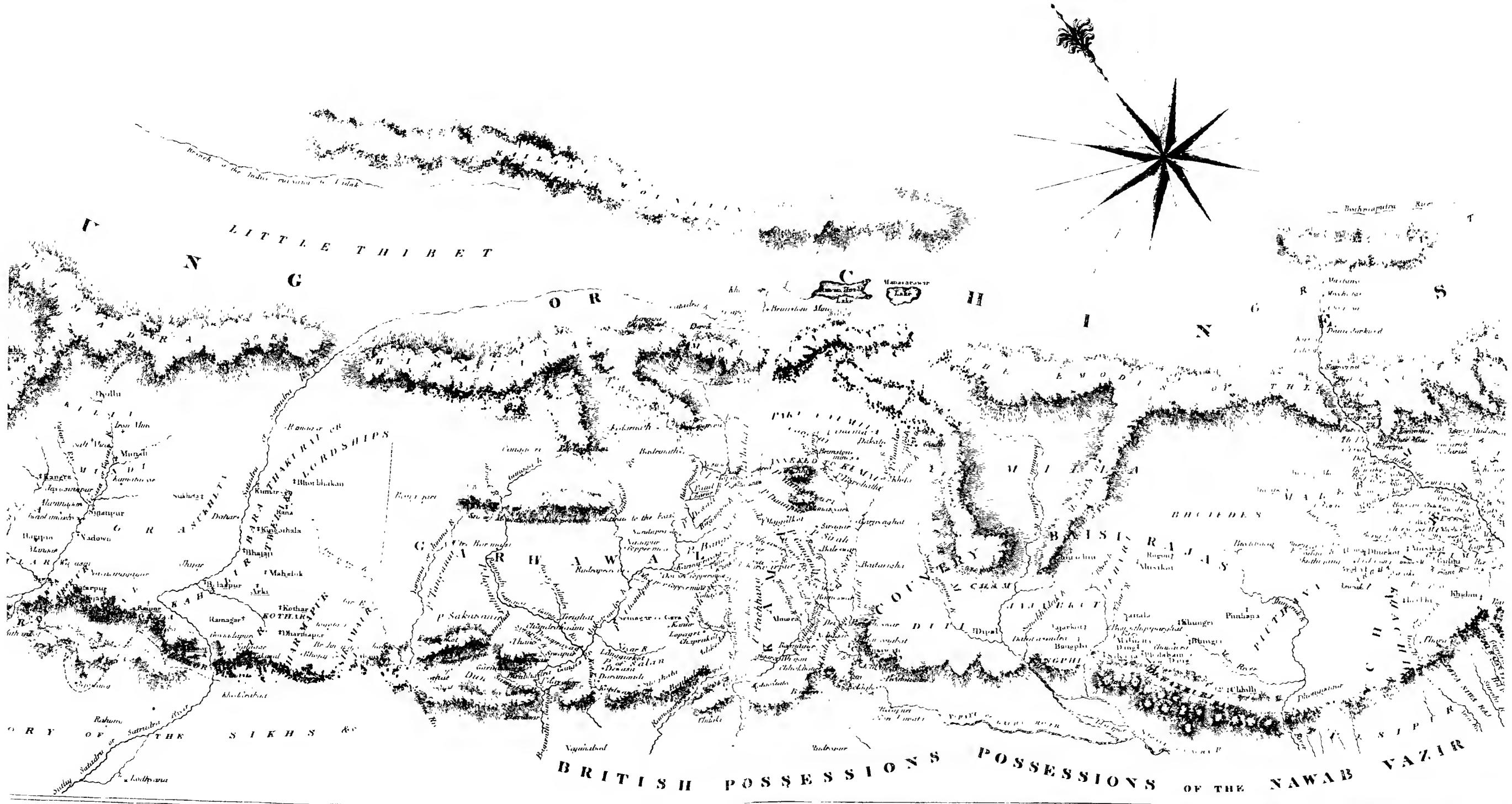
The use he made of the meagre information he obtained, gives great credit to Hamilton's perspicacity, and we must excuse him if he could not quite make out the complicated hydrography. Hariballabh alone is responsible for the contradictions in the statements. When this man says the two lakes are situated between two parallel ridges, and that the water flows from the Manasarovar to the Rakas-tal, he is correct. But when he talks of a river flowing from each end of the Rakas-tal, or rather from each lake, he is wrong, for, of course, either the one or the other must be the case. If he means that one river went out of each lake, he was probably right for the time of his visit. If he is the same man as Moorcroft's old Pundit, he had crossed the channel between the two lakes in 1796. But as he speaks also of the Satlej going out from the Rakas-tal, he may have visited the lakes again. In 1812 both issuing rivers were dry and Hamilton travelled in 1814. A rise may easily have taken place already at that time.

Hamilton does not say from which lake the Karnali starts; it flows to the east from the lakes, by which Hariballabh must simply have meant the neighbourhood of the lakes. Hamilton finds the Lama map in du Halde to be in perfect accordance with Hariballabh's information so far as the river, which Hamilton correctly recognised as the upper Indus, is concerned. Otherwise the accordance is only a coincidence, as for instance in 1812, the hydrography had a very different appearance to a hundred years before.

On the beautiful map, Pl. V, that accompanies Hamilton's work we find the course of the upper Satlej. The river is shown as issuing from the western end of the Rakas-tal. It receives from the north a small tributary and another from the south. The Karnali is represented as issuing from the southern shore of the Manasarovar. But there is no communication whatever between the two lakes, which is not in harmony with the text, but probably depends upon later and more reliable information from Moorcroft, whose journey was known when the map was drawn for publication. The Kailas is not represented as a peak, but as the "Kailasa Mountains", beginning straight north of the Manasarovar and stretching N. W. along the Branch of the Indus running to Ladak.

He has some interesting views as to the general hydrography of the Himalayas.¹ He observes that the Himalaya forms the boundary between Hindustan and Tibet and that it is perforated by many rivers, Indus, Satlej, Karnali, Gandaki, Arun,

¹ Op. cit. p. 91.



Francis Hamilton's Map of the Dominions of the House of Gorkha, 1819.

Brahmaputra, etc. Therefore he criticises Mr. Colebrooke who doubted that any rivers pierced the chain. For there is no doubt that the rivers he enumerates come from Tibet, and he asks: if, indeed, the Karnali arises from the lake Manasarovar, which is undoubtedly on the north side of the Himalaya, how could then Colebrooke be right? He also thinks Colebrooke is wrong in supposing the central Himalaya as bending to the north. It is more probable that it passes due west after being pierced by the Indus, and reaches the Hindoo Koosh of Elphinstone: while it is, in Hamilton's opinion, the western extremity of the northern ridge that turns to the north and separates Samarkand and Bokhara from Kashgar. Hamilton does not believe that the perforating rivers rise from any remarkable ridge of mountains, but that they spring from detached eminences on the elevated country of Tibet. The fact that the western branches of the Ganges came from the southern side of the Himalayas did not prove at all that the eastern tributaries could not rise from the northern side. Already Tieffenthaler had sketched the Gogra as coming from the Rakas-tal, and the same view was accepted by Hamilton as probable,¹ though he regarded the Manasarovar, and not the Rakas-tal as the source of this river.

¹ Compare also Ritter, II, p. 501.

CHAPTER XII.

THE LAKES AND THEIR SURROUNDINGS BEFORE THE JOURNEYS OF THE STRACHEYS.

Very little reliable information touching western Tibet was brought to the knowledge of Europe in the years between the visits of Moorcroft and the Stracheys to the sacred lake. In this chapter I have collected some scattered statements and discussions concerning the region in question.

In the *Journal Asiatique* we find a curious protest from MM VIVIEN DE SAINT-MARTIN and J. Klaproth concerning Tieffenthaler's map.¹ The protest was addressed to the Société Asiatique and shows that already 94 years ago there was a controversy as to who had the honour of having discovered the source of the Satlej. The two members think it just to observe, that the real source of the Satlej, which issues from lake Mansarovar, was very correctly entered upon one of Tieffenthaler's maps, and that the late Anquetil du Perron had entered it on his general map of the Ganges and the Gagra, where he had even entered the Persian legends of the original: the river Satlej flowing towards the Panjab.

From this fact the two famous orientalists think it obvious that the source of the river was known as early as in 1784 or 28 years before Moorcroft's journey.

L'honneur de l'avoir fait connaître en Europe appartient donc aux Allemands et aux Français, et non pas aux Anglais, qui s'attribuent maintenant tout le mérite de cette découverte.

The same thing could be said about the sources of the Ganges. On Tieffenthaler's map the river came out from Gangotri, whereas, until 1812, all English geographers had accepted the erroneous opinion of d'Anville, who, on the authority of the Jesuits in Peking, made the river originate from the Rakas-tal.

Suivant la grande géographie de la dynastie Thai-Thsing, le lac nommé Manas-Sarovar, ou Mansaroar par les Hindoux, s'appelle Mapinmou en Tibétain, et non pas Mapama, comme on le lit dans les cartes des jésuites. C'est de ce lac que sort la rivière Langtchou ou Setledj, qui coule à l'occident pour passer par le lac Langa, appelé Ravanhrad par les Hindoux. La jonction entre les deux lacs, niée gratuitement par M. Moorcroft, existe donc en effet; et la

¹ Jour. Asiat. Tome II, Paris 1823, p. 177.

première source du Setledj se trouve donc bien dans le lac Mansaroar, et non pas dans le Ravanhrad. Votre commission a pensé qu'il convenait de revendiquer en faveur des savans voyageurs français et allemands le mérite de ces découvertes géographiques.

This protest is only partly correct. But it also contains grave mistakes, and this is not the only case where the learned Klaproth was mistaken in his geographical speculations. He regards Tieffenthaler and Anquetil du Perron as more reliable authorities than the Lama surveyors and Moorcroft, although the two first-mentioned had never been to the place. He blames Moorcroft for denying the existence of the channel, although Moorcroft was one of the most reliable travellers who ever visited Tibet. He is correct in saying that the Satlej goes out from the Manasarovar and flows through the Rakas-tal, but he forgets that the Lamas had represented the hydrography exactly in the same way, although they mistook the river for the Ganges, instead of the Satlej. He blames the Jesuits for calling the lake Mapama instead of Mapinmou which, he says, is its Tibetan name.¹

Klaproth did not understand the periodicity of the effluent, for if he had he would have been more careful regarding Moorcroft. Ritter, who quotes only Moorcroft in his description of the lakes, as Moorcroft was the single eyewitness, is more clear-sighted. Comparing the information on the effluent to the Rakas-tal obtained by Webb, with Moorcroft's observations, Ritter concludes that the effluent is periodical.² The protest of Klaproth and Vivien de Saint-Martin only proves that geographical discoveries are seldom made at home, and that the observations made at the very place by such men as Moorcroft should not simply be denied.

I cannot desist from quoting here an extract from a description of Tibet which, some 85 years ago, was regarded as a very important source, and still may be remembered as classical on account of the great name of its author: ALEXANDER CSOMA DE KOROS:³

»The whole of Tibet occupies high ground, and lies among snowy mountains. Hence it is called in Tibetan books, by several poetical names, expressive of snow, ice, or frozen snow, cold, and high elevation. The highest ground in Tibet is in Nári, especially the peak called Tisé or Tésé, in Tibetan, and Kailasa in Sanscrit, about 80° E longitude, and 34° N latitude. The sources of the Indus, Setledge, Gogra and the Brahmaputra rivers are in Nári. There are several large lakes also.«

And further:

»There are also in Nári very extensive deserts. The inhabitants dwell in tents made of hair cloth; exercise a pastoral life, without any agriculture.«

¹ From the Tibetans I never heard any other name than Tso-mavang or Tso-mavam, which comes nearer to Mapama than to Mapinmou. Sometimes it is called Tso-rinpoche or The Sacred Lake.

² Dass der Ausfluss periodisch seyn sollte, hatte man auch Webb gesagt. Ritter, Bd. II, p. 660, 663.

³ »Geographical Notice of Tibet.« Journal o. t. Asiatic Society of Bengal N:o 4. April 1832, p. 121, et seq.

»There are four principal lakes in Tibet. The Ma-pham yu-ts'ho (Mansarovara), in Ñári, is the most considerable, of a circumference of about one and a half day's journey. In U-tsáng the Yarbrokyu-ts'ho, Mu-le-sgrum-ts'ho, and Ñam-ts'ho ch'hukmo are likewise of great extent. There are many others of inferior rank or less compass; as, that of Lá-nág to the west of Ma-p'ham. From Rúdok (near Ladak) to the east or south-east there are many salt lakes.»¹

¹ Csoma never entered Tibet. His sketch of the geography of this country, to which he was longing for such a great part of his life and at the threshold of which he died. — is only a compilation from Tibetan sources. It is therefore much more interesting than compilations made in Europe from European sources. Still I cannot help quoting one of them, not because its author, W. F. PALMBLAD, is a countryman of mine, but because it is very clever considering it was so early as in 1821. He describes the Lamas' journey to Kentaisse and the disturbances which prevented them from continuing their survey in S.W. Tibet. »Only from verbal description they drew the upper course of the Ganges, which they made start from 29° 30', and from that time flows on all maps, above the snowy mountains, an upper Ganges which is shown as taking its origin from a lake, Maunseroar, or from two lakes, or sometimes from four; then, after a long course to the west, it is made turning to the S.E. and, through the well-known waterfall, the Cow's mouth, rushing down the Hurdvar-mountains. As this cascade is situated at 30° N lat., cartographers found themselves obliged to remove the sources of the Ganges further to the north than reported by the Chinese astronomers. Thus d'Anville placed them at 36° N lat.; Tieffenthaler at 33° 15'; Arrowsmith, on an older map, at 34°. Finally it was proved by the journey of Raper and Webb, which was undertaken for the purpose, that the Ganges is formed by the Baghiratha Ganga, rising at Gangoutri, and Alakananda Ganga, coming from Bhadri-nath . . . Arrowsmith's map of 1816 was the first to note these geographical discoveries.» — The Magazine »Svea, Tidskrift för Vetenskap och Konst», Uppsala 1821, p. 9.

In his »Handbok i Geographien», Vol. I, part I, Uppsala 1826, p. 290 et seq. Palmblad has also an excellent description of Tibet, showing that he was very familiar with the whole literature on the subject existing at his time. »On the southern side of the Kailas-mountains, not far from the origin of the Leh-river, some source-branches begin, which form the river Setledshj (Satadru, Satudra); other branches it (the Setledshj) receives from the southern Himalaya mountains, and one, perhaps the main branch, from the lake Rawan-hrad. This lake is situated rather near the eastern one, the famous Manas-sarōwara or Mansarōwar, in the language of the country called Mapang. This lake, the most sacred of all water known by Hindus, has oval form . . . These are the two lakes which by the Lamas . . . were reported to be the sources of the sacred river, Ganges, just as the Burrainputer was shown as flowing from two other more easterly alpine lakes . . . It may be regarded as certain that one of the main branches of Setledshj takes its origin from the lake Rawan-hrad.» On different, quite correct grounds, he says that the mistake of the Lamas may willingly be excused. »And we should not forget that it is the opinion of all Hindu geographers, that Ganges has its source in Mansarowar which probably therefore has won its sanctity.»

As so many other geographers, Palmblad misunderstood Andrade, on account of the description of his journey given by Kircher. He specially refers to this place in China Illustrata, p. 49: Est in altissimis montibus Thebeth, perpetua nive carentibus, ingens lacus, maximorum totius Indiæ fluminum hydrophylacium, ex quo Indus, Ganges, Ravi, Athel natales suos ducunt. Therefore Palmblad says of Andrade that he finally reached the top of Himalaya, »and saw below his feet a great lake (probably Mansarowar), which, as he believed, was the common source of the Ganges and another great river which flows through Tibet (Tsanpu). This is also in accordance with Delisle's map of 1705.

Concerning the Indus. p. 565, he has also a very complete bibliography and arrives at the result that the source of this river must be situated much further away than formerly supposed. But its source is not known with certainty. He thinks it is situated N.W. of the Manasarovar, on the northern slopes of Kailas. The Shayok comes from the Kara-kurrum mountains, and is, on a part of its course, called Khamdan (Kumdan). Again he says: »Setledshj . . . has its origin from the lake Rawan-hrad . . . (p. 568). In the high region where Indus, Setledshj and Dzang-bo have their origin, are situated the two lakes Mansarowar (Ma-pang) and Rawan-hrad. The Hindus are firmly persuaded, now as in Andrade's time, that the Ganges, Setledshj and Gogra begin from here; this is without foundation;

In 1839 Captain Sir ALEX. BURNES gives us his views of the Indus and he has even a special chapter (XI) *On the sources of the Indus*, which shows the state of knowledge of his time.¹ But he says, as the whole of his information rests on the authority of others the credence to which it is entitled should be well weighed. The main Indus he regards as four times as great in volume as the Ganges in the dry season and nearly equal to the Mississippi.

The much greater length of course in the Indus and its tributaries, among towering and snowy mountains near its source, that must always contribute vast quantities of water, might have prepared us for the result; and it is not extraordinary, when we reflect on the wide area embraced by some of these minor rivers, and the lofty and elevated position from which they take their rise: the Sutlej, in particular, flows from the sacred Lake of Mansurour, in Tibet, 17,000 feet above the sea. The Indus traverses, too, a comparatively barren and deserted country, thinly peopled and poorly cultivated: while the Ganges expends its waters in irrigation . . . Moreover, the Ganges and its subsidiary rivers derive their supply from the southern face of the great Himalaya, while the Indus receives the torrents of either side of that massy chain, and is further swollen by the showers of Cabool and the rains and snow of Chinese Tartary. Its waters are augmented long before the rainy season has arrived; and, when we look at the distant source of the river, to what cause can we attribute this early inundation but to melting snow and ice?²

The difference he makes between the two rivers is only partly correct, as several of the tributaries to the Ganges rise on the Tibetan side of the Himalayas. He states that the sources of the great rivers of the world have always excited the particular attention of mankind; and that of none has our information been more conflicting and obscure than of the upper course of the Indus. After he had extended his journey into Tartary he made inquiries amongst the natives, which were assisted by Lieut. Macartney, though there is a great difference between Macartney's map and Burnes' results. Great, however, is the aid which one derives from the records of a preceding enquirer. And he expects much from Moorcroft's second journey, the results of which had not yet been published. When Burnes says: The following are our present and received opinions regarding the sources of the Indus,³ one would expect to get some new information about the real source, but he only tells us that the river of Ladak, joined by the "Shyook", falls into the Indus at Dras, a view which he materially improved by stating, that the river of Ladak, and the Shyook, instead of existing as two minor tributaries of the Indus, form of themselves the Indus; the one rising near the lake of Mansurour, and the other in the

doubtful is only, whether not a channel, though Moorcroft did not find any, goes from Mansarowar to Rawan-hrad, and therefore can be regarded as the source-branch of Setledshj . . .

Palmblad's discussion regarding this most interesting hydrographical problem was much more clever and scientific than many speculations of a much later date.

¹ Travels into Bokhara, etc. New edition. London 1839. His journey was undertaken some seven years before this date.

² Op. cit. Vol. I, p. 201.

³ Op. cit. Vol. I, p. 270.

north of the mountain of the Satlej, which has one source at least among its western ravines, and perhaps also of the Brahmaputra. The latter takes its rise in all probability among the eastern off-shoots of the Kailas; he was told that the Gogra arose in the Manasarovar lake, i. e. on the southern slopes of Gangri, or Kailas.

He is right only regarding the two first rivers, for really one of the source-branches of the Satlej can be said to rise on the western side of the Kailas, namely, the river of the valley Dung-lung, although it really comes from the southern slopes of the Transhimalaya,¹ on the other side of which the Indus rises. But this was unknown in Cunningham's days. It is not the first time we find the Brahmaputra to be supposed to rise on the eastern side of the Kailas or its off-shoots. The Gogra as rising from the lake is a revival of Tieffenthaler's opinion.

Cunningham finally discusses the question of the rise and fall of the Manasarovar, which Gerard had taken as proof of the existence of an outlet.² Cunningham correctly points out that if there is a rise and fall there cannot be an outlet, for an outlet should reduce the fluctuations. In August 1812, Moorcroft had considered the rise and fall to amount to four feet. But Cunningham, judging from the analogy of such of the streams north of the Himalayas as he had seen, calculates the levels of the lakes to occur in November, and thus the rise and fall of the Manasarovar could be estimated at 6 or 7 feet, a difference which, in his opinion, precludes the probability of a free egress for its waters, although it does not absolutely prove there is no such egress. The rise and fall of Rakas-tal was unknown and this argument does not affect the rise of the Satlej in it. Cunningham's belief was that the river had no connection with the lake.

On JOHN WALKER's map of Kashmir, 1842, illustrating G. T. VIGNE's book, the Ladak or Western Branch of the Indus is also called Sinh-Kha-bab or the Lion's Mouth. Between Chumba and Jammu, Vigne mentions a small lake Mansa, on his map, Manasa, of which he says: Mánṣa is an abbreviation of Manáṣa, the mind-born, and sarovara, or sara, a lake; i. e. the lake produced by the mind or will of Brahma, the creator. Of the same name, 'Mánsarovar', is the great lake visited by Mr Moorcroft, whence the Indus takes its rise.³ If he had studied Moorcroft more attentively, he would have found that he absolutely denies that any river takes its rise from the lake.

¹ At least one of its branches comes from Tseti-lachen-la. On the little map in my book 'Trans-Himalaya', Vol. II, this river has, by mistake, been drawn as if it were in some connection with the Indus, which is, of course, not the case. The mistake is, however, only to be found in the English edition, not in the Swedish original.

² Loc. cit. p. 236.

³ Travels in Kashmir, Ladak, Iskardo, the countries adjoining the Mountain-course of the Indus, etc., Vol. I, London 1844, p. 179.

In 1828, CARL RITTER presented to the Royal Academy of Sciences in Berlin a short monograph on the Himalaya.¹ His material he gets from Tieffenthaler, Turner, Elphinstone, Crawfurd, Hamilton, Herbert, Hodgson, Gerard, Webb, Fraser, Moorcroft, Forster, and others. All this material he discusses critically and a map is added, drawn by J. L. GRIMM from all English maps in existence². In the region of the lakes we easily recognise Moorcroft's and Hearsay's map.

In 1833, Ritter regards most of the country north of the western Himalaya as an absolute *terra incognita*. To this belong, amongst other parts, the country north of the upper Satadru or Satilej from Shipki up to the sacred lakes, and the whole valley of the upper Indus between Gartok and Leh and beyond.

Ritter shows that the travellers proceeded on four different ways from the south: Andrade and Moorcroft by the Mana- and Niti-Ghat, Herbert and Alex. Gerard along the upper Satilej by Shipki and along its tributaries, Moorcroft and J. G. Gerard by way of the source of the Jinab and the Paralasa range, and Desideri by way of Kashmir and Ladak. From all their accounts he concludes that north of the snowy ranges of the Himalayas a new land begins, a land without any deep eroded valleys and which the British explorers call a table-land, because here the high mountain-plains (Hochflächen) begin.³ Ritter supposes that the sources of the "northern Indus branch", by which he erroneously means the Garchung, must be situated at some thousand feet higher than the source lake of Satadru. In his special chapter on the sources of the Indus, Ritter does not and cannot follow any other authority than Moorcroft. Therefore he places the real source of the river west of the point where the Misar-branch begins, which, as we know, is only a tributary. For the Garchung or Gartang branch he also quotes Fraser, Herbert and Gerard.

From Moorcroft's account, Ritter gives the Satilej three source branches. The southernmost of these issues from the western end of the lake Rakas-tal.⁴ As to the two other branches of the Satadru he considers the one to come from Misar and the other from Tirtapuri. Only after the junction of the three branches, a little above Kyunglung, does the river get the name Satadru. Of course he makes the same mistake as Moorcroft, for the third main branch, the one issuing from Rakas-tal, is in reality the same as the Tirtapuri branch, and the Misar branch can never be called one of the three main branches.

¹ Entwurf zu einer Karte vom ganzen Gebirgssysteme des Himalaja nach den Quellenangaben. Berlin 1832.

² This map is entered in Ritter and O'Etzel: Atlas von Asien, and has the title: Karte von Hoch-Asien, zu C. Ritter's Erdkunde, Buch II, Asien, Th. 1 & 2. Bearbeitet von J. L. Grimm, Herausgegeben von C. Ritter und F. A. O'Etzel. Berlin 1832. Scale circa 1:6,400,000. A reproduction will be found in Vol. III of this work.

³ Asien, Band II, p. 588 etc.

⁴ Ibidem, p. 665.

From the same year, 1833, is GRIMM'S map of the Himalaya of Beshahr, Garhwal and Kumaun,¹ of which I have a part reproduced on Pl. VI. The hydrography of this map is almost entirely taken from Moorcroft, (Pl. III). There are only two important features which are not from Moorcroft. From the S.E. a river enters the Mapang or Manas-sarowar, corresponding to the Tage-tsangpo or uppermost Satlej. But there is no Samo-tsangpo, so the connection with Gunchu-tso, as misunderstood by Gerard, has not been accepted on the map. The difficulty caused by the fact that Moorcroft had not been able to find any kind of connecting channel between the two lakes is overcome by Ritter and Grimm in marking with a dotted line a channel across the southernmost part of the neck of land between the lakes. Here we read the very interesting legend: *beide Seen verbunden durch einen period. Flusslauf*, which shows, clearly enough, that Ritter understood the physical necessity of an effluent, the existence of which had more than once been affirmed from native information. As Moorcroft had not found it in the northern part of the neck, it must be situated in the southern, where Moorcroft had never been.²

The brook Crishna, corresponding to my Sölung-urdu, is separated from Mamjo Kampa³ by a pass, Ghati Behroun, for which Tieffenthaler is responsible.

As to the source of the Indus, Moorcroft had wisely written: Supposed source of the Indus Rr. at the origin of the Gartok branch, which Ritter has translated in the more positive form: Indus-Quellen. The N.E. branch he calls Singzing-Kampa, in accordance with Gerard (Pl. IV).

The lakes are situated between two very solid and powerful ranges running N.W. to S.E. Cailasa Peak is shown as rising from the range which Moorcroft calls Cailás, and Gerard, Kylas. S.E. of Kailas there is a Kentais-se or Gangdisri Mountain. Darchan is, as on some other maps, also called Gangari.⁴

In 1834 Ritter points out the fact that all that was known about Tibet was brought from Chinese sources and missionaries who had no gift of observation, although, if he had known the manuscripts of Desideri and Beligatti, he would have changed his opinion. Even using all the material in existence, he finds that the result of a discussion becomes like a dream in the darkness which disappears, and so it had to be until some really well prepared naturalists crossed the country in different directions, of which, so far, he did not know a single example.⁵

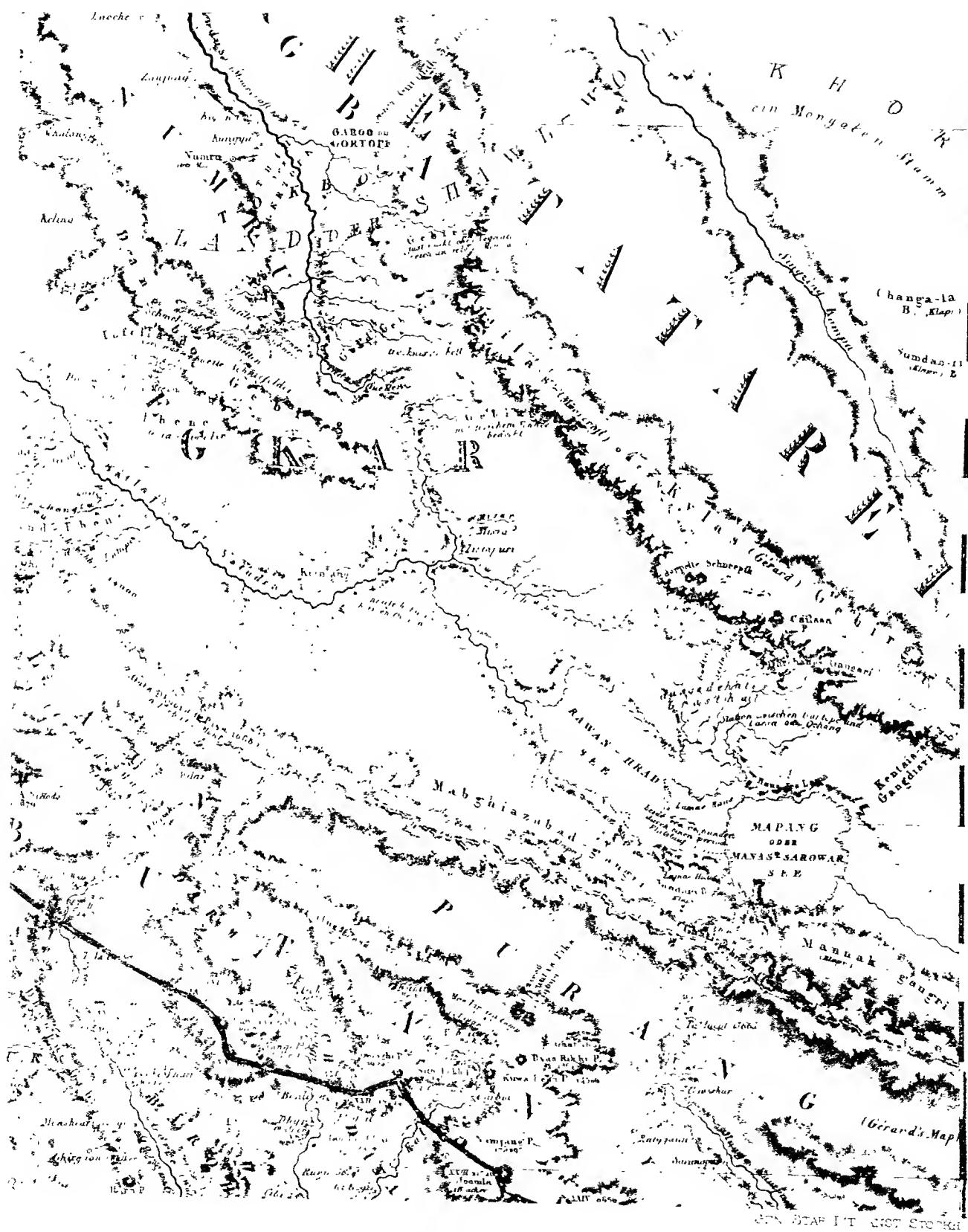
¹ Das Himalaya Gebirg in Bissahir, Gherwal & Kemaun, vom Sudrande des Plateaus von Mittel-Tibet bis zum Tieflande von Hindostan. Mit besonderer Rücksicht auf Carl Ritter's Allgemeine Erdkunde II. Buch, Th. 2., s. 493, auch s. 660 ff. entworfen und bearbeitet von J. L. Grimm, herausgegeben von C. Ritter und F. A. O'Etzel. Berlin, 1833. Scale: 1 : 900,000.

² From Moorcroft's narrative it is obvious that he never went to the southern part of the neck. The legend: »Mr Moorcroft's Route on the 6th August to examine if this Lake had any communication with Rávan Hrad and found none», is therefore put on a wrong place on Moorcroft's map, Pl. III.

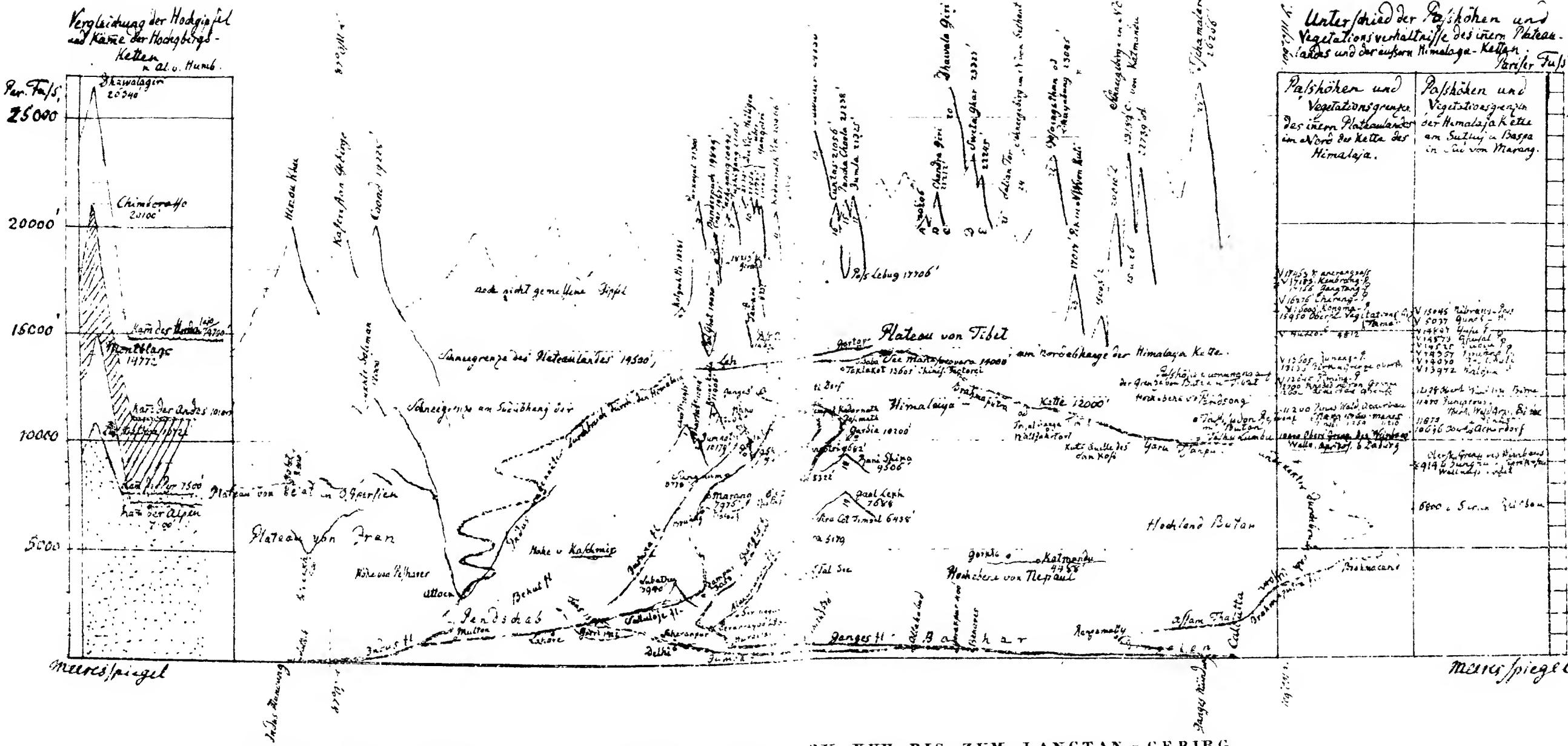
³ Mapchu-kamba.

⁴ Four years later Ritter observes that both the map of Grimm and Klaproth's map of Central Asia leave very much to be desired, and that both in some respects had been completed by Burnes' map. Asien, Bd V, p. 390. Berlin 1837.

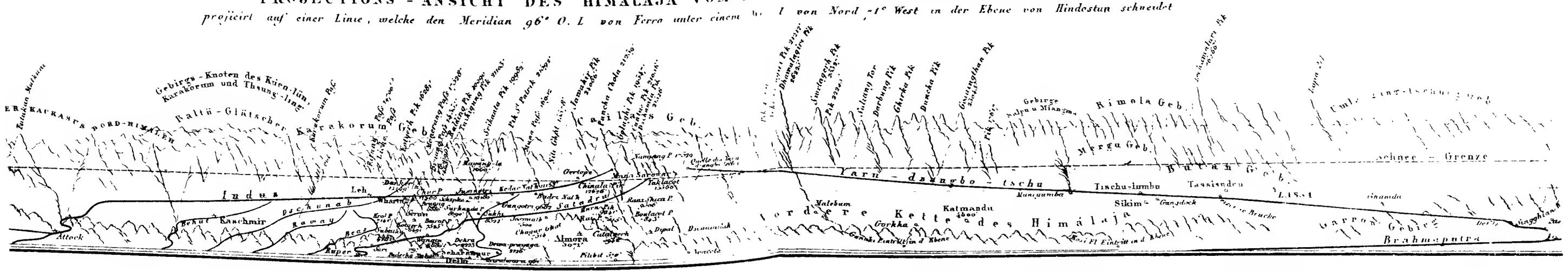
⁵ Ritter. Asien, Bd III, p. 172.



The Lakes and surrounding regions on the map of Grimm and Ritter, 1833.



PROJECTIONS - ANSICHT DES HIMÁLAJA VOM HINDU-KUH BIS ZUM LANGTAN - GEBIRG,





Facsimile of Klaproth's hand-drawn map of the Lakes and the Sources of the great Indian Rivers; about 1820.

From available sources Ritter places the snow-mountain Kailas in the N.E. of the Tibetan province of Nga-ri and gives it 9 geogr. miles in circumference. It is steep on all sides and from its eternal snow innumerable springs pour constantly down. It is considered as the highest of all mountains and is called the Oneuta in Hindu books. Round it are situated the four animal mountains, the k'hababhs, in the form of a horse (Tam tsioogh), an elephant (Lang tsien), a lion (Sengghe) and a peacock (Mabghia).¹ At another place² he says the Hindu name for the mountain is Kailas, the Chinese is Oneuta or O-neou-ta and the Tibetan is Gang-dis-ri or 'Snowcoloured mountain', from which d'Anville's maps have got their Kentaisse. In his opinion both the sources of the Indus and the Tsangpo are situated on the Kailas, and from this mountain mass the Kara-korum stretches N.W. and the snowy ranges of Hor or Khor and of Dzang to the east, a question to which we shall have to return later on.

Clearer than words the diagrams, of which I have two reproductions, will give a graphic idea of the knowledge attained by European geographers about 1830, regarding the mountains and rivers of southern Tibet. The first of them the upper part of Pl. VII, is taken direct from the original hand-drawing of the great Asiatic scholar, Carl Ritter.³ It shows the absolute and relative height of some prominent peaks. About the middle of the diagram we find the Plateau of Tibet with the Manasarovar, supposed to be at 14,000 feet. From its western end the Satlej issues, breaks through the Himalaya, and joins the Indus. The latter river has its source a little above and west of the Manasarovar. The Brahmaputra is supposed to start from nearly the same height as the lake and from a point just east of its eastern margin. It is specially pointed out that the transverse valleys of both the Indus and Brahmaputra were unknown.

The lower part of Pl. VII, is from a sketch by J. L. Grimm.⁴ The Rawen Hrad and Manas Sarowara are at one and the same level. From the western end of the western lake the Satudra or Setlej goes out. The same relations are shown in a somewhat different form on another hand-drawn profile, by Grimm.⁵

Pl. VIII also shows a map of very great interest, not only because it is the reproduction of the hand-drawn original of the famous orientalist Klaproth, and there-

¹ Ibidem, p. 219.

² Asien, Bd. II, p. 414.

³ This unique diagram is preserved in the Cartographical Institute of the Royal Library in Berlin, under the number E. 5740. I am indebted to the kindness of Professor Dr H. Meisner, Director at the Royal Library of Berlin, for being enabled to enter not only these most interesting diagrams, but also several maps, especially those of Klaproth, Ritter and Berghaus, most of which will be published in Vol. III. Professor Meisner had these diagrams and maps photographed for me at Berlin, and Miss G. Scheele provided them with very detailed titles from the originals. For this valuable assistance I express my sincere gratitude.

⁴ Höhen-Verhältnisse vom östlichen Hochasien, Entworfen von J. L. Grimm. -- E. 120 (Profile) in the Royal Library of Berlin.

⁵ Its title is: Höhen-Verhältnisse des Himalaya in Sirmore, Gurhwal, Kemaon. — E. 5750 in the Royal Library of Berlin. The reproduction is only a part of the whole diagram.

fore unique, but also because it is the first European map on which the results of recent exploration were combined and brought into harmony with the descriptions in Chinese geographical works, the sources of which have been quoted above.¹

I regard this map as a master-piece of perspicacity. Klaproth has faithfully followed the descriptions given by the trustworthy and reliable Chinese authors, and combined them with Moorcroft's and other travellers' results so far as possible, and has therefore arrived at a result that surpasses everything that before 1820 had been laid before the public. Some details were altered on Klaproth's great map in four sheets of Central Asia, published in Paris, in 1836. On his preliminary sketch of 1820 some features are more salient than there. We are, at the first look at Pl. VIII, struck by the draughtsman's logical and natural way of reasoning. From the dry and conscientious Chinese descriptions, which do not leave the smallest room for fantasy, Klaproth has got a strong impression of the existence of very sharply defined drainage areas, the Indus to the N.W., the Satlej to the W.N.W., the Ganges to the south, and the Brahmaputra to the east. From this hydrographical arrangement, so sharply defined by the Chinese, he concludes that the different river basins must be separated from each other by considerable mountain ranges. His river systems are therefore very sharply reflected in his mountain systems. The Chinese are masters in describing river-courses, but they have no sense for mountains; rivers are very well shown on their maps, mountains badly. Therefore Klaproth's ranges on his map are artificial. Round the lakes he has an ellipse, from which ranges are radiating in all directions. From the interior borders of the ellipse the drainage goes to the lakes. Farthest east is Lac Goungtchou (Gunchu-tso), which, in accordance with Chinese texts,² stands in communication with the Manasarovar. But the Chinese let the river from Gunchu-tso join the Tage-tsangpo or uppermost Satlej, whereas Klaproth makes the two rivers enter the Manasarovar at different places.

Klaproth calls the sacred lake Lac Mapama or Mansarowor and makes it discharge its superfluous water through a channel, in spite of Moorcroft who had travelled only a few years earlier. Klaproth had greater confidence in the Chinese than in a European traveller, and in this case he was right, though, as I have said above, Moorcroft was also right for the year 1812. Klaproth even places the channel across the northern part of the neck.

The western lake he calls Lac Langa or Rawen-Reddor. From where he has got the latter name I can not tell. Reddor has a certain resemblance to Desideri's Retoa, which I believe is miswritten for Retok or Rudok. This can only be a coincidence, for Klaproth did not and could not know Desideri's narrative.

Farther west he cannot do better than to follow Moorcroft's map, so much the more as his map is confirmed by the Chinese texts. Tirtapuri, however, is

¹ Carte du Pendjab et de la partie occidentale de l'Himâlaya. [Handzeichnung von Jules de Klaproth] [cirka 1820. Maassst. c. 1:1,250,000]. Royal Library of Berlin. E. 6740, $\frac{3}{4}$ of the original.

² Vide Vol. I, p. 120.

placed, as by Moorcroft, on a wrong river. The joint Satlej breaks below Koung-loung through the eastern part of the mountain ring, and continues beyond it under the name of Langtsing-khampa. Thouling (Totling) is placed at some distance south of the river, as on Moorcroft's map, and Tchebreng (Tsaparang or Chabrang) has no more been placed on the river, than it was on the Lamas' map.

The name Kailas is missing on the map. The source of the Indus is placed due north of Rakas-tal, and so far correct, that it is separated from the Satlej lakes by a mountain range, the northern part of the ellipse, and from the eastern drainage by a more or less meridional water-parting. This branch of the Indus he calls Riviere Seimzheing-khampa, and correctly regards it as the main branch, and real source of the Indus, a fact that was doubted by much later geographers.

On his great map of 1836¹ Klaproth has made some alterations in the hydrography, and very considerable improvements in the orography. The mountain ranges are much less dependent on the drainage areas than on the sketch of 1820. The Tibetan names of the Indus and Satlej are improved to Singhe tchou and Langtchou; the lakes are called Mapham mtso or, in Sanscrit, Manas Sarowar, and Lang mtso, Langga, or Rawan head.² As to the drainage area of the Manasarovar, Klaproth now seems to return to d'Anville's Lama map, (Vol. I, Pl. LI), with which at least the eastern affluents have an unmistakable resemblance. The source of the Satlej is marked in accordance with the Chinese and d'Anville, and called M. Langtsian kabab ghang ri, for Lantchia Kepou, as d'Anville has it. From this mountain, at the present day called Ganglung-gangri, the Satlej goes down to Gunchu-tso and farther north-west-wards to the Manasarovar, at the very place where in reality the Tage-tsangpo is situated. East of the source of the Satlej is M. Tamtsiogh kabab ghang, or the source of Tamchok-kamba, the Tsangpo or Brahmaputra, which we shall have to deal with separately.

Regarding the small rivulets entering the Manasarovar from N.E., the nameless one coming from a little lake is undoubtedly Samo-tsangpo, as may be deduced from Pl. LI (Vol. I). D'Anville's L. Conghé is, namely, identical with Klaproth's L. Goungd.³ Matchoung and Dzie mai tchou occupy the valleys of what we know as Pachung and Pachen.

Though M. Tise, Tese Ghang, Ti se ri, or Kaï las'a is now entered, the mountain wall, which on the sketch of 1820 separated the basin of the Indus from that of the Satlej lakes, has disappeared, at least there is an interruption just above the source of the Indus. M. Sengghe kabab ghang ri is so far wrong that Singi-Kabab only means and indicates the source of the Indus. I never heard this

¹ Carte de l'Asie Centrale dressée d'après les Cartes levées par ordre de l'Empereur Khian Loung, par les Missionnaires de Peking, et d'après un grand nombre de notions extraites et traduites de livres chinois par M. Jules Klaproth. Paris 1836. (4 sheet. scale 1 : 2,600,000). — D. 8 620 in the Royal Library of Berlin.

² Obviously misprint for hrad.

³ Misprint for Goungé.

name attached to any mountain or range in this region. In any case, and even under the form it has got on Klaproth's map, the name corresponds to the two other *kababs*, namely, those of Satlej and Brahmaputra.

To his map of Himalaya, published in 1835 by Justus Perthes in Gotha, Dr. HEINRICH BERGHAUS chiefly used the material of Webb, Hodgson and Herbert, but also that of Fraser, Moorcroft, Hearsay, Gerard, Traill, Mundy, Skinner, Archer, and Johnson.¹ So far as our lakes are concerned we recognise Moorcroft's map entirely. Under the title of the map we find the following legend: Thirty five geogr. Miles S. E. of the lake Mapang, at the eastern foot of mount Langtsian lobal gangri, the source Djima Yungrun is situated, from which the Yaru Zzang bo tsiu, the great stream of Tübet, takes its origin. He has a place, Mansarowar, on the north shore of the lake of the same name. On a river entering the lake from N. E. we read the legend: Effluent of the Tschungka Lake; and on one from the S. E.: Effluent of the Gungiu Lake. The latter river occupies the place of Tage-tsangpo, which is the same confusion that Gerard made.

South of the lake is Mannak gangri, the Gurla-mandata, and south of it Tieffenthaler's Behroun Pass, and still farther south, N'gari Burang. The latter word is Purang. Both Behroun and Burang have a considerable resemblance with EDRISSI's Berwan.²

The great German cartographers as a rule published memoirs on their maps in the same way, though more detailed, as Rennell had done. In one such analysis Heinrich Berghaus makes a comparison between Moorcroft and Hearsay, and Webb, and finds such a great coincidence between their maps for the regions within Himalaya, that Hearsay's map, in spite of his insufficient equipment with instruments, must be regarded as very reliable for the regions north of Himalaya as well.³

In another memoir, ZIMMERMANN seems not to be persuaded by the hydrographical ground-lines as generally accepted in 1841. He represents the Indus as coming from a lake, and when he uses the expression Quell-Seen des Indus', he probably means the Manasarovar and Rakas-tal.⁴ In those days the importance of glaciers as feeders of the great Himalaya rivers was not yet understood. Zimmermann gives a much too great importance to the lakes. He says that just like many European rivers, several rivers in Asia, as the feeders of the Amu-darya, Indus, Chinah,

¹ Spezial Karte vom Himalaya in Kumaon, Gurhwal, Sirmur &c. &c. — Reproduced as Pl. IX.

² On his map: Vorder-Indien oder das Indo-Britische Reich, N:o 44 b in Stieler's Hand-Atlas, 1834, Dr H. Berghaus has given the lakes a somewhat different form (Pl. XXII). On his great map of Central Asia: »Karte von China und Japan, der Manen d'Anville's und Klaproth's gewidmet», 1843, in Berghaus' Atlas von Asia, the same distinguished cartographer has followed the representation on Klaproth's map of 1836, Vol. III, Pl. XIII.

³ Geographisches Memoir zu Erklärung und Erläuterung der Spezial-Karte vom Himalaya, Gotha, 1836, p. 42.

⁴ Geographische Analyse der Karte von Inner Asien von Carl Zinmermann, Berlin 1841, p. 121.



THE HIMALAYA

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Entworfen nach den astronomisch-trigonometrischen Vermessungen der

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stehen die wahrscheinliche Zusammensetzung ihrer Testosteron- und Progesteron-
hormone. Operiere also ungenugend Werkzeug der Endokrinologie und
größer Einblick in die Erkrankung gewonnen wird.

1877

1835

100

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Bemerkung – Die Blankheit erkennt es anzuführen dass ausser den Beobachtungen und Vermessungen der oben genannten Offiziere die Beobachtungen und Bezeichnungen von Fraser, Moorefield und Hearsey das Bruder Gerard, Traill, Mundy, Skinner, Arches und Johnson bei dem vorliegenden Kartenwerk bereits wieder sind. Hinzu kommt der Tatsache Darstellung habe ich geachtet mich um eine allgemeine Anleitung der Scherbenkette und des südlichen Gebirges zu beschreiben zu müssen welche weil der Zug mancher Bergketten nicht genau genug bekannt ist eine künstliche Bequemlichkeit in vielen Fällen nur vorsätzlich gewesen war würde ich mir um die Deutlichkeit der Karten keinen Fingern auf zu thun. Hierdurch giebt der Lauf der Gewässer hinreichende Anleitung zu einer Orientierung der heutigen Sowjetischen Hohen schulen und in Toren angegeben. Die punktierten Worte gründen sich auf Berichte von Ingelschorn.

HR

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10

2

ANSWER

Satlej, and others come from lakes.¹ He does not trust the course of the Indus as indicated on maps, and does not feel persuaded that the river at Attock is the same as the river of Ladak.²

¹ Ibidem, p. 109. I do not know what he means by quoting a Mr. Court who is said to mention a lake Mansorur in Bajore situated on a mountain 15 koss from Bendy Berravol, which is continually supplied with water in consequence of the perpetual snow. Speaking of high alpine lakes he uses the expression: Der Munsorur-See bei Bajore, der einzige bekannte des Indischen Kaukasus. Ibidem, p. 119.

² His own words are: Nach den abgegebenen Zeugnissen derer, welche den oberen Lauf des Flusses nur an einzelnen Punkten oder gar nicht sahen (Mir Isset Ullah, Vigne, Henderson, Moorcroft, Burnes, Higgin), bleibt es immer noch zu argwohnen, dass der schmale Fluss von Attock vielleicht nicht der ist, welcher schon bei Ladakh eine grosse Breite hat und ob dieser wirklich der von Iscardo ist Eine Thalreise von den heiligen Quell-Seen bis Attock ware ausserst wunschenswerth. — Ibidem, p. 102.

CHAPTER XIII.

HENRY STRACHEY.

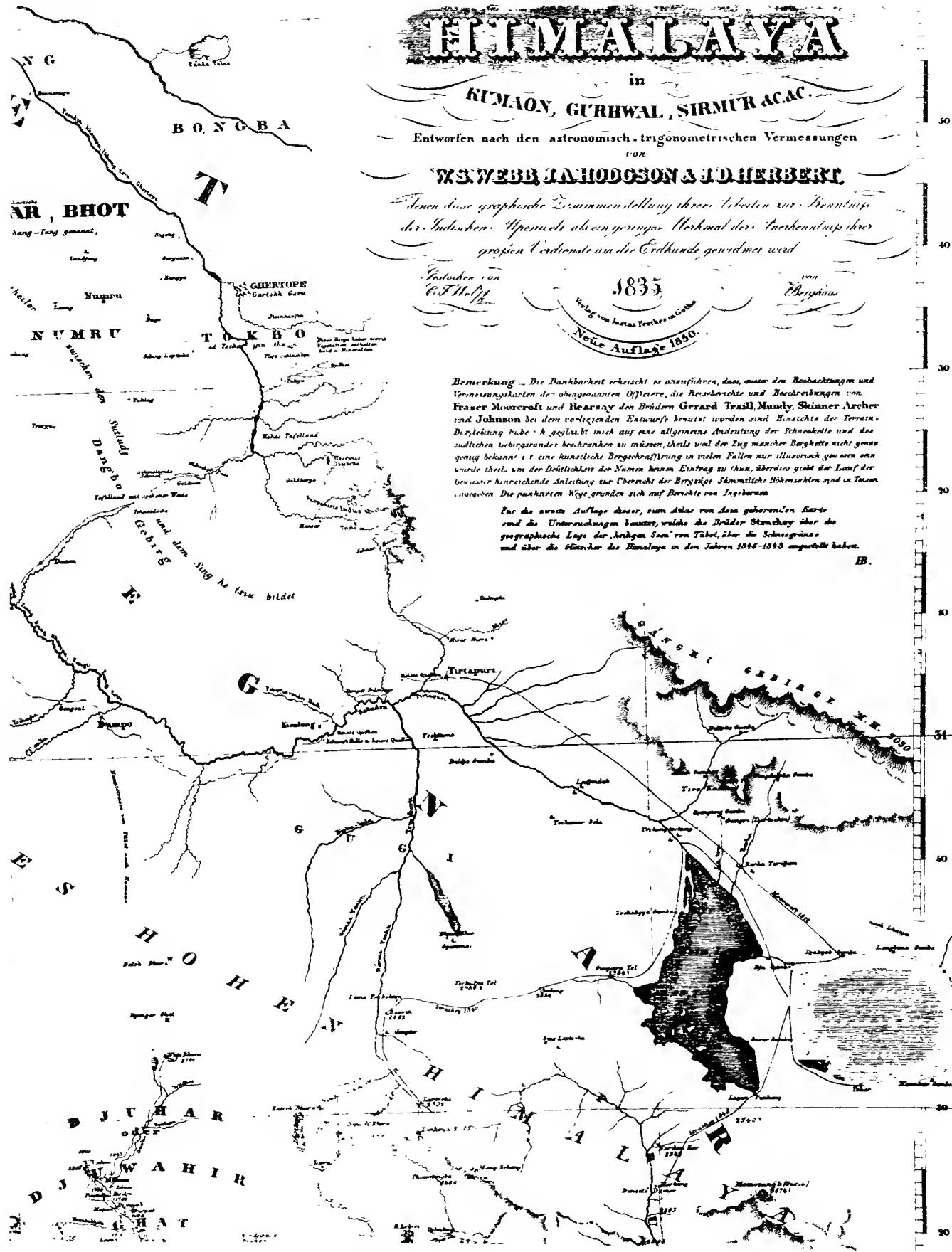
We now come to a classical account of a journey to the lakes and surrounding regions, namely that of Lieut. HENRY STRACHEY, who visited these places in September and October 1846.¹

Already at Askot he met two fakirs who, during the two last years, were said to be the only ones who had succeeded in reaching the Manasarovar *via* Byáns, a fact which he did not regard as a lucky omen for his own journey. And still he not only succeeded, but also brought back a great amount of personal observation, which put the whole hydrographical problem upon new and firmer ground. I will here mention some of the most important results of his exploration.

He went up the Kali river in Byáns, and left the road to Lípu-Lekh to his right. The upper Kali was called Kunti or Kunti Yánkti. He gives a very detailed description of the pass Lánkpya Dhúra (17,750 feet). His first camp north of the pass was Larcha, from where he could see through the opening northward a glimpse of distant blue mountains, which he supposed to be part of the Gángri range, on the north side of the Sutlej. Then he followed the valley of the Dárma-Yánkti. Two or three miles down he passed an opening from the south-westward through the mountain on the left, coming in two branches from the Dárma passes, Nyue and Kach, which communicate this way with Húndés. The Dárma-Yánkti has derived its name from its alleged origin in this quarter, though as far as he could see, by far the principal body of the river is that by which he had descended from the base of the Byáns, and not the Dárma, Himáchal . . .

At his camp Láma Choktan he saw, on October 2nd, the north-western horizon bounded by the Gángri range tipped with some snow. In its middle rises the snow-capped Peak of Kailás, somewhat higher than the rest of the line. A few miles northward the Dárma-Yánkti is joined by Gúnda-Yánkti, rising from the Dárma

¹ Narrative of a Journey to Cho Lagan (Rakas Tal), Cho Mapan (Máناسارówar), and the valley of Pruang in Gnari Journal Asiatic Society of Bengal, Vol. XVII, Part II, 1848, p. 98, 127 and 327 et seq.



Heinrich Berghaus' map of 1850.

Himálaya. Below the junction the river is called Chu-gárh. After having received another tributary it runs nearly parallel to the course of the Sutlej. This river Chu-gárh falls into the Tirthápúri branch of the Sutlej. He corrects Moorcroft's mistake about the Tirthápúri branch.¹

Strachey found that the little lake near Gyanima occasionally gives off its surplus water into the Chu-gárh. Farther on rises a range of hills concealing the bed of the Tirthápúri Sutlej. During the rainy season the Chu-gárh was found to be a very considerable stream, sometimes unfordable, and perhaps even equal to the Tirthápúri river. It is the furthest eastward of the large feeders which the Sutlej receives from the Indian Himálaya, and may be considered as one of the main sources of that river. He is of course perfectly correct in regarding the Chugar as one of the sources of the Satlej, although the river cannot be called the principal source, as will be proved in a later chapter.

Strachey observed the curious fact that some of the sources of the Satlej and Karnali were situated very near each other and divided only by an almost level plain. One could walk in an hour from the one to the other without ascending or descending more than 500 feet. He finds a similar case regarding the source of the Gartok Indus, which he also knows as Bíphu-kula, and the Misar Sutlej, which are separated only by the comparatively low pass of Jilkwá-lá,² and he thinks a third example could be found with the Jáhnavi above Nilang, the main source of the Ganges, yet unexplored by Englishmen.

Continuing his journey from Lámá-Choktán he went due east to Chujia-Tol. The name of the Gurla was Momonangli in Tibetan, and he estimates the mountain at 23,500 feet.³ The Himalaya, seen from the northern side, was found to exhibit a much more gradual and flatter general declivity, with smoother and rounder slopes than the vast rocky walls of the southern face, and still he is right in observing that the Himalaya terminates generally abruptly in the table-land and the transition is well defined, as he thinks also the climate to be. As a rule he finds the climate of the plateau land to be dry and a snowfall of three days at Gartok was considered a most unusual circumstance.

Via Amlang and Jungbwa-Tol he approaches Rakas-tal. The following important passages should be quoted in full:

«I had determined to begin with Rákás Tál, because it was less known than Máناسarovar, though geographically more interesting, as being suspected of communication with the Sutlej; being no resort either for pilgrimage or for Bhótia traffic, the western Lake has been

¹ «Moorcroft noticed the debouchment east from the route on the opposite bank of the Sutlej (15th August 1812) but erroneously supposed the stream to come from Rákás Tál, and Hearsay's map has made the same mistake, inconsistently with Moorcroft's own previous observation at Tirthápúri (31st July), to the effect that the Tirthápúri branch of the river came from Rákás Tál, which it does to some partial extent.» (Strachey.)

² Jerko-la, 16,200 feet.

³ Colonel Burrard gives it as 25,355 feet. — A Sketch of the Geography etc. Part I, p. 3.

less observed by Hindustani visitors, and from its intricate outline less easily comprehended and described by them

He then gives an excellent description of the western shore of Rakas-tal and is right in saying the southern shore is so irregular, that it has to be surveyed in detail if an idea of its form is to be gained. He passed the Chabgá Gumba without seeing it. The name of the lake was found to be Cho Lagan, and it is not sacred.

At the shore he found marks of variation in the water-level to the extent of a few feet. The water was quite pure and sweet, so the thick efflorescence of salt he found on lately inundated, swampy ground, was supposed to arise from the soil.

Henry Strachey regarded the eventual connection between the two lakes and the Satlej as an essential object of his journey. Regarding the effluence of Rakas-tal, he arrived at the following conclusion:¹

:There is no visible channel from the lake, and the only effluence is by filtration through the porous soil of the intermediate ground, unless it be at times of extreme flood, when the level of the lake may possibly rise high enough to overflow the margin at this corner. The stream so formed flows westward, through an open valley; below Changchung it receives the Sar-chu, a rivulet from the deep ravine immediately west of Kailás; the united stream then takes the name of Lajandák, which is also an encamping ground on its banks about a day's journey from Gángri Moorcroft's statement regarding the Tirthapuri river (12th August), agrees with this account of mine, though not with his own of the 15th, when he made the Chugárh come from Rákas Tál. Hearsay's map makes the same mistake, and on the 13th idem, he describes two of the four tributary streams from the Gángri mountains large enough to be bridged with Ságas, though he did not notice them on his way out to Mánasarowar, 1st and 2d August. The effluence of Rákas Tál probably contributes less to the Sutlej than others of its numerous sources in the Gángri mountains, or the Indian Himálaya, for the Bhotias say, that the stream at Lajandák, even after it has received the Sar-chu, is very inconsiderable. It is a question that can be decided only by actual measurement perhaps, whether the main source of the Sutlej be not in the Dárma-Yánkti, for the discharge of the Chúgarh sometimes, though not constantly, exceeds that of the joint Tirthapúri and Misar river, as the Bhotias testify, who are in the habit of fording both streams, close above their confluence at Pálkia. The former is liable to great floods in the summer, the discharge of the latter being more equable throughout the year.,

Thus Henry Strachey did not find any direct and superficial effluence from the Rakas-tal. The only effluence was by filtration, although he does not say to what depth this filtration goes. He finds it likely that at times of extreme flood there may occur a superficial overflow as well. Moorcroft's mistake as to which branch comes from the lake will be best understood from Hearsay's map (Pl. III). The Tirthapuri Satlej cannot be said to be equable throughout the year. On the contrary, the fluctuation in the volume of water is enormous. After heavy rains on the southern slopes of the Gangri and surrounding mountains, the northern tributaries grow to furious torrents. Supposing that rains chiefly touch the Himalayan side, the Dárma-yánkti will get the most of it and grow to a river several times as big as the

¹ Loc. cit. p. 156.

Tirtapuri Satlej. If we compare the two branches and ask which of them should be reckoned as the original source of the Satlej, I should give this honour to the one which has the longest course and comes from the highest and most extensive glaciers. As a rule the Tirtapuri branch gets its water only from Transhimalayan glaciers. But the Tage-tsangpo belongs to the Tirtapuri branch, even if it only periodically continues as an effluence from the Rakas-tal. The length of this period is of no significance whatever. So long as the lakes are not completely cut off and becoming salt, they belong to the Satlej system. As a very important argument in favour of the Tage-tsangpo I regard, as shown before, the fact that the Chinese and Tibetans themselves have regarded it as the source of the Satlej and thus there is a historical as well as a natural argument in its favour. Under such conditions it does not signify much that the Darma-yankti occasionally exceeds the Tirtapuri branch.¹

Henry Strachey gives a good description of Kailas. He has heard the names of the four temples round the mountain and calls them: Nindi, Dödiphu, Jungdulphu, and Gyuktang, the last mentioned situated in Gangri or Darchen. The Sar-chu, coming from the Kailas, joins the channel of Lajandák. He knows both Dolma-la and the Gauri-Kund lake, although he never saw them. He found that the small streams La-chu and Barka were the only permanent affluents to Cho Lagan from the Gangri mountains.

In attempting to find a channel of effluence from Cho Lagan he went a good way westward towards Changchung and was floundering about the swampy ground for a long while seeking in vain for the channel that did not exist. To escape observation from Parka he passed at night along the northern shore towards the east and found the La-chu 150 feet wide and 3 feet deep as a maximum. Two miles farther on he crossed the Parka river, which was like the other, but a third smaller in width and depth.

On October 5th he continued eastward at a little distance from the shore of Rakas-tal, until he reached the eastern horn of the lake.

>A mile on, we came to a large stream 100 feet wide and 3 deep, running rapidly from east to west through a well-defined channel: this was the outlet of Mánasarowar. It leaves that lake from the northern quarter of its western shore, and winding through the isthmus of low undulating ground, for four miles perhaps, falls into Rákas Tál in the bight formed by the projecting headland above mentioned. Two or three miles to the eastward, we saw the back of an odd looking eminence, in the face of which was Ju-Gumba, a Láma-shrine on the west

¹ I insert here, as Pl. X, the new edition, for 1850, of Berghaus' map: Spezial Karte vom Himalaya in Kumaon, Gurhwal, Sirmur, &c. &c. (Compare Pl. IX). The title of the map is the same as for the edition of 1835. Only the following words are added: Fur die zweite Auflage dieser, zum Atlas von Asia gehörenden Karte sind die Untersuchungen benutzt, welche die Brüder Strachey über die geographische Lage der »heiligen Seen« von Tubet, über die Schneegrenze und über die Glätscher des Himalaya in den Jahren 1846—1848 angestellt haben. The map will therefore not only serve as a good illustration to Henry and Richard Strachey's journeys, but also show the knowledge of our region as it was in 1850.

bank of Mánasarowar . . . Having forded the river, the deepest we had yet crossed, we ascended a little on to higher ground . . .

Going south-east he reached Cho Mápán. The figure of Mápán is, as stated by Moorcroft, an oblong with the corners so much rounded off as to approach an oval, the longer diameter lying east and west: 15 miles in length, 11 miles in breadth, 45 in circumference at the water's edge; 4—6 days for the pilgrims' wandering round the lake. To the east he found a distant view precluded by hills; only the Gangri range to the north and the Nipál Himálaya to the south were to be seen.

»The view which I have obtained of Mánasarowar confirmed my belief of the accounts of native informants which all agree in stating that the lake has no other affluents than a few unimportant streams rising close by in the surrounding mountains, and but one effluent, that communicating with Rákas Tál, which we crossed this morning. The two lakes are placed together in a basin, girt about by an enceinte of hill and mountain, from which the only exit appears to be at the north-western extremity opening into the valley of Lajandák.»

As Strachey never visited the eastern shore of the lake, he could not get any impressions at all of the size of the affluents from the east. From his route along the western shore they cannot, of course, be seen at all. But the information he received from the natives was right, although the Tage-tsangpo is not inconsiderable when compared with the rest.

The seemingly extraordinary difference between his own and Moorcroft's observations on the effluence, he tries to explain in the following way: »The outlet of Mápán leaves the lake from the northern quarter of the west side. I was much puzzled to account for Moorcroft's failure to find the mouth of so large a stream as that we forded this morning, till at last I heard on good authority, that the entrance of the channel is completely closed by a large bar of sand and gravel, continuous with the shore of the lake, and the effluent water runs through this in a copious stream.» He quotes Moorcroft who searched in vain at Ju-Gumba, with the outlet immediately under the S.W. side of it concealed merely by the bank upon the edge of the bay. His opinion of Moorcroft's reliability is not favourable. He thinks it was a pity that Moorcroft did not get the company of some intelligent Hunia, who would have explained all such matters as this, and have removed many other doubts and errors in the course of his explorations. Moorcroft was sufficiently intelligent himself not to need any explanations of Hunias. His narrative was the first reliable and one of the most conscientious ever written on the hydrography of these lakes. And, as shown above, he also quotes the opinion of the natives.

Henry Strachey reckons 3 or 4 permanent affluents of Mápán. First, a stream, rising in two branches from the Gángri (Kailas) mountains, and flowing into the lake at the eastern quarter of its north side; the second also from the Gángri range, a few miles farther east, entering the lake at the north-east corner: at the very same point is the mouth of the third stream, which rises in Hortol. The presence of three streams accounts, as Strachey found, for the greater verdure which he

observed in the ground above the N.E. corner of the lake. Concerning the fourth affluent he felt doubtful; a stream possibly comes from the Nipál Himálaya into the S.E. corner of the lake, but of this he could get no certain account. Except these four affluents which no doubt correspond to my Pachen, Pachung, Samo-tsangpo and Tage-tsangpo, there were, in the summer season, many temporary streams from rain and melted snow, and he thinks it probable that it was one of these that Moorcroft saw, and called the Krishna river, on the S.W. corner of the lake.

He found out the following approximately correct names of the 8 *gompas*: Tokar, Gusur, Ju, which he says are situated on the north bank of the Nikás effluent, Jakyab, Langbuna, i. e. elephant's trunk, Bundi, Sárálung, and Nunukur, but he had no occasion to visit any one of them.

The water of Mápán he found quite clear and sweet. He supposes the average depth of the lakes is 100 feet or so, and the maximum he believes to be the double. It is a pity he desisted from going round the lake, on account of his followers being afraid of detection. Such a wandering, he says, should have lead only to a little nearer approximation to the true figure and size of its outline and to the exact position of the few unimportant affluent mountain streams and the temples round the bank. He could not know that one of these affluents in later years should be regarded as not so very unimportant. Putting together Moorcroft's and his own observations, supplemented with native information, he regards the geography of the lakes as approximately fixed, though his map cannot pretend to be topographically accurate.

On October 6th he began his return journey on the isthmus between the two lakes, and here he entered on a small bay of the lake, then half dry, with great quantities of efflorescent salt about the swampy ground. Strachey's description of this bay proves that it had not changed at the time of my visit in 1907. It also proves that a rise of the lake, which is sufficient to feed an emissary of 100 feet in breadth and 3 feet in depth, is not sufficient in any notable degree to change the actual appearance of the salt bay on the west shore. It is, however, probable that this marsh contained more water in 1846 than in 1907. Strachey's account puts it beyond doubt, that even in periods when the lake is overflowing through the Chiu-channel, the marsh does not send any emissary underground to the west, as, if it did, the water of the marsh could not remain salt.

He reached the S.W. corner of the Manasarovar, where he saw no sign of any affluent and the nature of the ground precluded an effluent. At the south-eastern corner of Rakas-tal he saw the indented outline of the shore as well as the small islands. Gerard was found to be wrong when reporting the existence of a monastery on one of these islands.

Finally he continued south-westwards and found a ravine from Mount Gurla full of granitic shingle. He went down to the valley of Karnali and passed Taklakhar, called Takla-kot in Hindustani. Then he crossed the Lipú-Lekh pass and again entered the valley of the river Kali.

He mentions the four rivers rising, according to Tibetan mythology, from the Gangri or the lakes. His informant properly distinguished legend from fact. The first is the Indus, Sing-Chin (or Jing) Kamba (or Kampa) on the northward, fabled to spring from the mouth of the Lion; the second is Lang-Chin Kamba on the westward (the Satrudra or Sutlej) from the mouth of the ox (Lang), although he translates Lang with elephant at another place; the third, on the southward, is the Map-chu Kamba (the Kárñáli) from the Peacock (Mapchu); the fourth is the Brahmaputra to the eastward, or Tamjyak Kamba from the Horse.

The term Yang-Tang was found by Strachey to denote uncultivated pastoral high lands in contradistinction to Rung-Tang, which signifies low lands with villages and agriculture. He heard that on the north side of the Gangri mountains there was a valley height, Bong or Bongbwa, Tal, Yang-Tang, inhabited by shepherds and salt carriers. He also got news about the salt and borax fields and the gold mines north of Bong, which he regarded as the Ultima Thule of Gnari.

These are the chief contents of Henry Strachey's brilliant article on his famous journey to the lakes, by which he has laid a ground of immense importance for the investigations of our days. He proved by his observations and report that the statements of the Lama surveyors regarding the channel were perfectly correct, although Moorcroft's narrative seemed to have indicated the reverse. If other travellers, as Moorcroft, had positively denied the function of the channel, nobody would have believed in the correctness of the Lamas' map. One would have felt tempted to regard it as a fraud or a mistake, or, at the most, one would have accepted the possibility of a connection with the Satlej ages ago, as in the case of the Panggong-tso and Shayok. But, thanks to Henry Strachey's journey, it was positively proved that the communication existed in the autumn of 1846. Geographers, however, do not seem to have explained this fact as a periodicity. Even Henry Strachey himself did not at all understand the cardinal point of the problem. In a very unfortunate way he tried to explain the cause why Moorcroft had not seen the channel between the two lakes, which was found already on the Lamas' map and which Strachey had seen with his own eyes. If Strachey had had sufficient confidence in Moorcroft, he would necessarily have discovered the periodicity of the pulse of the lakes.

A map illustrates his paper. It is superfluous to discuss those parts of it which were not visited, only seen from a distance by Henry Strachey. He correctly represents the Tise or Kailas as not belonging to the range of »Gángri Mountains», but shows it as rising from a spur south of the range (Pl. XI). The Samo-tsangpo he has entered, but does not know from where it comes. Judging from this passage in his text he has got some correct information about the road along this river: »In Hor-Tal, somewhat this side (i. e. west) of the Tankcham-Tarjum, which is the next east of Samoo Takchin, there is a third lake, the Gungyut.»¹ Of the Tage-tsangpo

¹ Loc. cit. p. 330.



Part of Map of West Nari, with the adjoining Provinces of the Indian Himalaya to illustrate Capt. H. Strachey's Memoir on the Physical Geography of Western Tibet.
(Journal R. G. S. Vol. 23, 1853).

there is no trace on his map. The part of the country where the river is situated is crossed by a very distinct mountain range starting from the Gurla range and stretching N.E. Everybody who, from the Gossul-gompa, has looked over the lake and the country beyond, will easily understand this mistake.

Although he did not see any superficial water running from the Rakas-tal to form the upper Satlej, he has, on his map, entered that river as starting from the lake. To both lakes he gives a height of 15,250 feet, which is very near the correct height.

Strachey has written a special article: *Explanation of the elevations of places between Almorah and Gangri*,¹ on which we do not need to enter as the heights given have now lost their value. To the map, of which only a part accompanies his paper, he adds an article under the title: *Note on the construction of the Map of the British Himalayan Frontier in Kumaon and Garhwál*.²

Some five years later Henry Strachey published his classical monograph: *Physical Geography of Western Tibet*.³ Here he expresses some perfectly correct views regarding the West-Tibetan rivers in general. Neither the length of the course nor the area of the basin is any sure index to the volume of water. Much more depends upon the position of the sources as regards snow. As the Indian Himalaya has a much greater quantity of snow, the southern rivers are incomparably fuller than those farther north. Therefore he believes that for instance the Singitsangpo, after a course of more than 400 miles, scarcely exceeds in volume the upper part of the Lungnak river not 50 miles from its farthest sources. The discharge of the Sanskar river, after running only 200 miles may be tenfold of the water brought

¹ Journ. Asiatic Society of Bengal, Vol. XVII, Part II. 1848, p. 527 et seq.

² Loc. cit. p. 532, where the following passage is important: »In the Trans-Himalayan part of my map, I have copied all of the Indian Atlas No 65, which shows the explorations of Moorcroft and Hearsay in 1812, taken, I believe, from actual rough Survey of Hearsay's, though not so acknowledged on the map, and the positions there assigned to Gartokh and all the principal villages, rivers &c., in the route of those travellers, remain unaltered up to longitude 81°, saving the direction of a stream here and there, which I had reason for knowing to be otherwise. East of that longitude, where the Atlas No 65 terminates, is the result of my own explorations now recorded, including the lakes with the details of Kailás, and Gángrí, the eastern and south-eastward sources of the Sutlej, the sources of the Karnáli, Momonangli and the valley of Pruang, with its numerous villages. — It would have been interesting and useful to compare my delineation of the lakes, and adjacent places, Gangri, &c. with Hearsay's map of the same, but I have not been able to find any authentic copy of the latter, including the parts east of long. 81°, which lie outside of the Atlas No 65; the last mentioned map does indeed show the north-western part of Rákas Tal, with an effluent falling into the Sutlej between Tirihapuri and Kyunlung, but this at least, I have proved to be quite wrong, no part of the lake extending so far west, and the river in question being properly the Dárma Yánkti, rising in the Byáns Himalaya . . . In other respects Hearsay's map, as also Moorcroft's narrative, agrees very well with the information I have received from the Bhotias, and I have been able to identify many points of the route of those travellers with the Bothias' description.»

Very modestly he concludes: »My map does not pretend to any accuracy of execution, for which I had neither the requisite mechanical appliances nor sufficient time . . . The Trans-Himalayan ground, nowhere fully explored or accurately surveyed, is of course open to much correction.»

³ Journal Royal Geographical Society, Vol. 23. 1853. p. 1 et seq.

by the Ladak Indus in double that course and from double the area of country. »Rivers of considerable volume sometimes issue ready formed from glaciers.«

It is strange that hardly any other traveller in these interesting parts of Tibet than Henry Strachey has pointed out this important fact. I found a striking example of the truth of this physical law at the source of the Brahmaputra. There it is obvious that the branch, Kubi-tsangpo, which comes down from a group of Himalayan glaciers must be the principal source and not such branches as those which come from the dry Chang-tang or rise near to its border.¹

Therefore Henry Strachey concludes that the scanty volume of the Singi-tsangpo or source branch of the Indus proves that there is no active effluence of any extent from the north. The gradual subsidence of the Panggong-tso proves also that this lake received little affluence from the east.

One can of course, as Strachey does, speak of the *source of greatest volume* of the whole Indus and place it in the head of the Monlung of Lingti where the rivers of Sanskar and Lungnak rise. The source of greatest volume of the Shayok he places in the Kumdan glaciers, whereas the Yapchan river is the longest source branch of the same. Here, however, he omits the branch from the Remo glacier. He points to the fact that if there were any active effluence from Panggong-tso, and the main trunk of the river extended to the farthest affluent of the lake eastwards, the Kumdan river would be reduced to a tributary and the extreme length of the main river would be increased probably to 400 miles.

Here he touches a problem to which we have a striking analogy in the combination Satlej—Manasarovar—Rakas-Tal. The eastern half of Panggong-tso, the Tso-ngonibo, is fresh as it has an effluent to the western half which is salt as being cut off from the Shayok-Indus. As Strachey himself had seen water flowing from the Manasarovar to Rakas-tal and supposed the latter had a temporary effluent, he had no cause to make a comparison with the changes which have taken place with the Panggong-tso. Nobody knows whether the desiccation will continue in future at the same rate as hitherto. But if it does the Rakas-tal will meet exactly the same fate as Panggong-tso and the Tso-morari and become salt, whereas the Manasarovar will continue to remain fresh for a much longer period. This is only a future prospect; but as long as both lakes are fresh and still have temporary effluence, they belong to the Satlej. In this respect Strachey had no doubt, and therefore he makes no comparisons.

He calculates the longest trunk of the Tibetan Indus at 750 miles from its farthest sources in Seng Tot to Lower Balti. The highest point upon the main Indus attained by Strachey was Demchok. But Moorcroft and Hearsay had seen the river at Gartok. Therefore the Indus may be said to be positively determined for nearly 700 miles. Concerning the real source he says: 'Little or nothing is known

¹ Regarding the important part played by glacier sources we shall return to this matter in Chapter XXIX, p. 205.

of the furthest source in Seng Tot or elsewhere, and the estimate of 50 miles for the remaining course depends upon native reports and conjecture. It was Henry Strachey who mapped the upper half of the well-known 550 miles throughout Ladak; the lower half through Balti was mapped by Lieut. R. YOUNG. The first reliable knowledge was conquered by Moorcroft, TREBECK and VIGNE.

Henry Strachey discusses the problem of the sources of the Langchen or Guge Satlej in a most clever way.¹

In fact, Strachey had to make his choice amongst several different sources, and as he did not know the country east of the Manasarovar he leaves the question open. It is, however, curious that he could at all think of Gunchu-tso, although he knew that it had no active effluence. But he may have been misled by the information given by Gerard. He makes, however, a correct and strong difference between Gunchu-tso and the two other lakes: The basin of the Langchen is lacustrine in its upper part, containing the Konkyu Lake in Horba without active effluence, and Tso Mapham and Langnak in Kangri with a partial or intermittent one.² The great volume of water in the Satlej he explains from its comparatively southern situation. He could have explained the cause why the Gunchu-tso has been cut off earlier than Rakas-tal, if he had used his own physical law. For Gunchu-tso is situated nearer the dry plateau-land and fed from the border of Chang-tang, whereas the Manasarovar and Rakas-tal are fed from the snowy Himalaya. From the same cause Panggong-tso has been isolated at a much earlier date than the Satlej lakes, about which we even do not positively know whether they are going to be completely cut off at all.³

¹ He says that these sources are somewhat complicated (as imperfectly known to us), lying between the Chukar (i. e. White River) from the Indian Himalaya on the S., the Ser-Chu (Gold River) or other streams from the mountains of Kangri on the N., and the effluence from the lakes Mapham and Langak on the E.; the two first being permanent, and the last partial or intermittent; and besides these, there is the dormant drainage of the Horba basin, which stagnates in the Lake of Konkyu on the extreme S.E. The Chukar is said to be as large as the united river of Mensar (Misar) and Tirthapuri, when swelled by the melting of the Himalayan snow in summer; but we do not know whether it maintains this superiority on the average of the year, nor whether the intermittent contribution of the lakes be equal to the permanent affluence of the Ser-Chu, or other rivulets direct from the Kangri mountains; but the difference in both cases is perhaps small. Measured from these various sources, the length of the Langchen will be — from the Darmia Yankti head of the Chukar, about 230 miles; from the head of the Serchu, behind Kailash, 245 miles; from the furthest affluents of Manasarowar on the S. E., 255 miles, which includes about 45 of the intermittent lake drainage; and from the watershed of Maryum La, at the S. E. extremity of Horba, probably about 320 miles, including 65 miles for the dormant drainage of the Konkyu basin.» Ibidem p. 39.

² Ibidem, p. 36. At another place, p. 48 ibidem, he says what sounds as a contradiction, that the Gunchu-tso has no effluence, yet no high ridge between it and the lakes of Kangri, and certainly belonging to the same system of drainage; the water salt.

³ Strachey further gives the following information about the rivers of Ngari: »The river that carries the drainage of Nari-Mangyul and Utsang to the north-eastward is called by the Tibetans the Tachok Tsangspo, i. e. Horse River. The best of my Ladak informants could not assure me positively of its course below Lhasa, but assented fully to its identification with the main trunk of the Brahmaputra river, as asserted (and all but established) by the geographers of Bengal. The river which drains the greater part of West Nari to the north-westward, called by the Tibetans Senge-Tsangspo, i. e. Lion River, is now

As a general rule embracing all the lakes of Ngari, Strachey regards the fact that none of them can ever have been much fuller than they are now, or 100 vertical feet. In this respect he should have found a great difference between them and the lakes of the interior plateau-land, where certain lakes, as Lakor tso, have been up to 430 feet higher than now. The Ngari lakes, he says, are never found below 14,000 feet. Those with an effluence are invariably freshwater, those without it invariably salt..

In his monograph, Strachey has given a good characteristic of the two famous lakes, which he calls, in Tibetan, Tso Mapham and Tso Langak or Oma Tso, i. e. Milk Lake. He believes that the spur of low hills between them consists partly of alluvial material projecting from the foot of Gurla. Both have purest fresh water.¹ His description of the hydrographical situation of the much debated lakes is very good indeed, and Strachey clearly understood that he had to do with a periodical phenomenon.

well-established (by the explorations of Mr Vigne and subsequent surveys of Lieut. R. Young) as the chief source of the Indus — a fact which English geographers have had to rediscover for themselves within the last half century, though I find it distinctly stated in a book written by a Tibetan monk 250 years ago.

But the Indus is not the only river of West Nari; all the S part of Nari-Khorsum, and a small eastern corner of Maryul, are drained by the heads of the Indian Satadru, v. Sutluj, the chief of which, called by the Tibetans Langchen Tsangspo, i. e. Elephant River, originates in the southern part of the transverse watershed that divides Nari-Khorsum from Mangyul (the heads of the Indus occupying its northern part), and breaks through the Indian Himalaya in Upper Kanor.» Ibidem, p. 8.

¹ «The eastern lake Mapham is of oblong or oval shape, 15 or 16 miles long E. and W., and 11 to 12 broad N. and S., making an area of 150 square miles. It is known to have several affluents from the high snowy mountains that flank it on the N. and the S., though the English explorers, confined as yet to the W. side, have not actually crossed any of them; and one of them, from the Kangri mountains on the NE., is said to form a small fresh-water lake, called the Tso Khurgyal, shortly before its debouchure into Mapham. Its effluent runs through an opening in the hilly isthmus into the western lake: I found it a swift stream 100 feet broad and 3 deep in October; and its exit from the lake was seen by Mr J. E. Winterbottom and my brother, Richard Strachey, from a height a few furlongs off; though Moorcroft crossed this very place without finding the stream, even in August, the time of highest flood—whether from its being then dry, or from its percolating through a bar of shingle close to the lake, as asserted by some of my native informants, is not apparent.

The Western lake Langak has probably about the same area as Mapham, but an irregular shape, with a length of 20 miles N. and S., and extreme breadth of 15, measured obliquely across its S. end, the N. end narrowing off to a point; at the S. end there are two or three small rocky islands, the only known instances of such in the lakes of West Nari. My brother and I have between us completed the circuit of this lake, so as to leave no doubt of its affluents and effluents; the former comprise the effluent of Mapham above mentioned, two streams from the Kangri mountains on the N. E. as large as that, and a much smaller one from the valley of Jungba in the hills on the S.E. The effluence to the Langchen river is from the point, which I crossed however in October without finding any running stream, or any marked channel for one, though the flatness of the ground, its partial inundation in shallow pools, and obvious descent of the level towards the river, entirely corroborated the native accounts of an intermittent effluence in seasons of flood. It is worthy of notice that one branch of the Jungba valley is connected with valleys draining into Gyanima of Guge; and the level of both so nearly flat, and the dividing watershed so insensible, that the depression of a few feet at this end, with an equal elevation at the N. point of the lake, would certainly turn the effluence into the Chu Kar, through the plain of Gyanima, where there now exists a small lake 5 or 6 miles long and 1 in extreme breadth.»

He is not correct in saying that the Tibetans seldom have any name for their rivers, but simply call them Tsangpo, Tokpo or Chu. If they have names these chiefly belong to the valleys. For nearly every river in the inhabited parts of the country has a name. The term Kabab or Khabap he translates Vomitory Cataract or Fountain and is right in saying it more applies to the mere source than the whole river.

As to the watersheds he has found that they are by no means observant of the main mountain ranges, the connection or separation of basins being often determined by cross fissures and secondary ridges.

An excellent *Map of West Nari* is added to Strachey's paper. A mere glance at this map, Pl. XI, would convince everybody that the source of the Satlej is to be searched for S.E. of the Manasarovar. The effluence from both lakes is strongly marked, disregarding its periodical character. Kailas is correctly shown as a peak situated south of the Transhimalaya. The source of the Indus is placed too far east.

CHAPTER XIV.

RICHARD STRACHEY.

A new important addition to our knowledge of the lakes was given by Sir RICHARD STRACHEY in the narrative of his journey in September 1848, which he accomplished in company with Mr J. E. WINTERBOTTOM. The results were published in full more than fifty years after his journey.¹ He started from Milam and took the road of Topi Dunga, Laptel, Shangcha, Tisum, from where he emerged on the plain of Guge. In the upper part of the valley of Gori he came upon the base of the great fossiliferous series of rocks which constitute the ranges over which the passes into Tibet are situated. Richard Strachey called this line of elevation the Indian Watershed of the great Tibeto-Himalayan tableland. At Tisum he found that the plain of Guge appeared to be quite flat and open for some 10 miles to the north, but it ended abruptly on the south. The Jankum river had cut out a huge furrow from the plain with sides sloping about 45°. The ravines, 200 or 300 feet in depth, opened up sections of the plain showing that it consisted of a great deposit of gravel and boulders and sand. The surface of the plain was found to slope towards the Satlej and the beds were deposited parallel to the surface. As he descended he found that the alluvial beds rested on shales and shaly limestones which generally dipped to the N.W. Boulders and pebbles in the river bed consisted mostly of calcareous rocks but a notable proportion were composed of porphyries, only one or two specimens of granite being seen. In the shales near the Satlej he found an Ammonite and Inoceramus showing that the strata were either Jurassic or Cretaceous.

He deals with the hot springs of Tirtapuri and Kiunglung, although he did not visit them personally. On the road from Ligchepu to the Darma Yankti he finds a great difference between the rivers in the eastern and western parts of Guge. The western flow in very deep ravines, whereas the eastern are shallow, about 25 feet only below the surface of the plain. This difference he finds to depend upon the increasing depth of the bed of the Satlej on its way towards the west and upon

¹ »Narrative of a journey to the lakes Rakas-tal and Manasarowar in Western Tibet.« Geographical Journal, Vol. XV, Febr. 1900, p. 150 et seq., March, p. 248 et seq., and April p. 394 et seq.

the fact that the Satlej and its tributaries run more in solid rock in the eastern parts of the plain, and more in soft alluvial matter in the western parts.

Beyond the Gunda Yankti some 4 miles more of the plain brought him to Darma Yankti, which was larger but similar in character. For the two last days to Gyanima the plain was level or gently sloping, covered with shingle. The abrupt rocks around or rising from the level of the plain suggested that he travelled over a dried-up bed of some great lake or inland sea. As his brother Henry, he was told that from the lower end of the Gyanima lake a stream issues and joins the Darma Yankti, which soon afterwards unites with the Gunda Yankti, after which the combined river is called Chu-kar. East of Gyanima he enters a hilly country forming the eastern boundary of the plains of Guge. He thinks the deposits of Guge have been formed by the ocean. The valleys east of that plain show that they have carried much more water in olden times.

The watershed of Rakas-tal was found to be 15,200 feet, or 200 feet above the lake. Here for a short distance he touched ground where his brother had been in 1846. But Henry Strachey went north, Richard Strachey and Winterbottom south of Rakas-tal. On the way to this lake eruptive rocks were found and on the southern shore hypersthene rocks predominated. The Tibetan name of the lake was found to be Tso-Lanak. As his brother, he calls Gurla, Momanangli.

His plan was now to go to the north-western corner of the Manasarovar, where the point of efflux of that lake was supposed to be. This we were anxious to see, for Moorcroft had denied the existence of any opening there, though my brother had crossed a large stream some miles to the west of Ju, which he was informed came from Manasarowar.

He had hoped to be able to go along the edge of the lake, but when he came to a little shingly bay, the steep cliffs forced him to ascend again over the hills, where the ground in parts was almost level. On September 16th he proceeded 14 miles from Rakas-tal to the Manasarovar. At the commencement of this day's march hypersthene trap was still found, after which followed mica schists, and fragments of granite. He is not sure whether any granite in situ was crossed, but Gurla seemed in great part to consist of granite.

He made the following observations on the isthmus:

»The ground separating Manasarowar (Mapham) from Rakas-tal rises rather steeply to about 300 or 400 feet above the level of the lakes, being apparently altogether composed of alluvial deposits made up of pebbles, precisely similar to those now found on the beaches of the two lakes, of granite, mica schists, and quartzites, sometimes cemented together and forming conglomerates, but more commonly in the state of loose gravel. The general structure of this alluvial mass is so perfectly identical with that of the deposits of the great plateau that they must all be held to have had a common origin; but it is impossible to offer any opinion as to the probable time at which this particular portion assumed its present position relatively to the rest, whether before, with, or after the general movements that have elevated the whole. — We kept for some distance along the top of the separating ridge, till a hollow that nearly

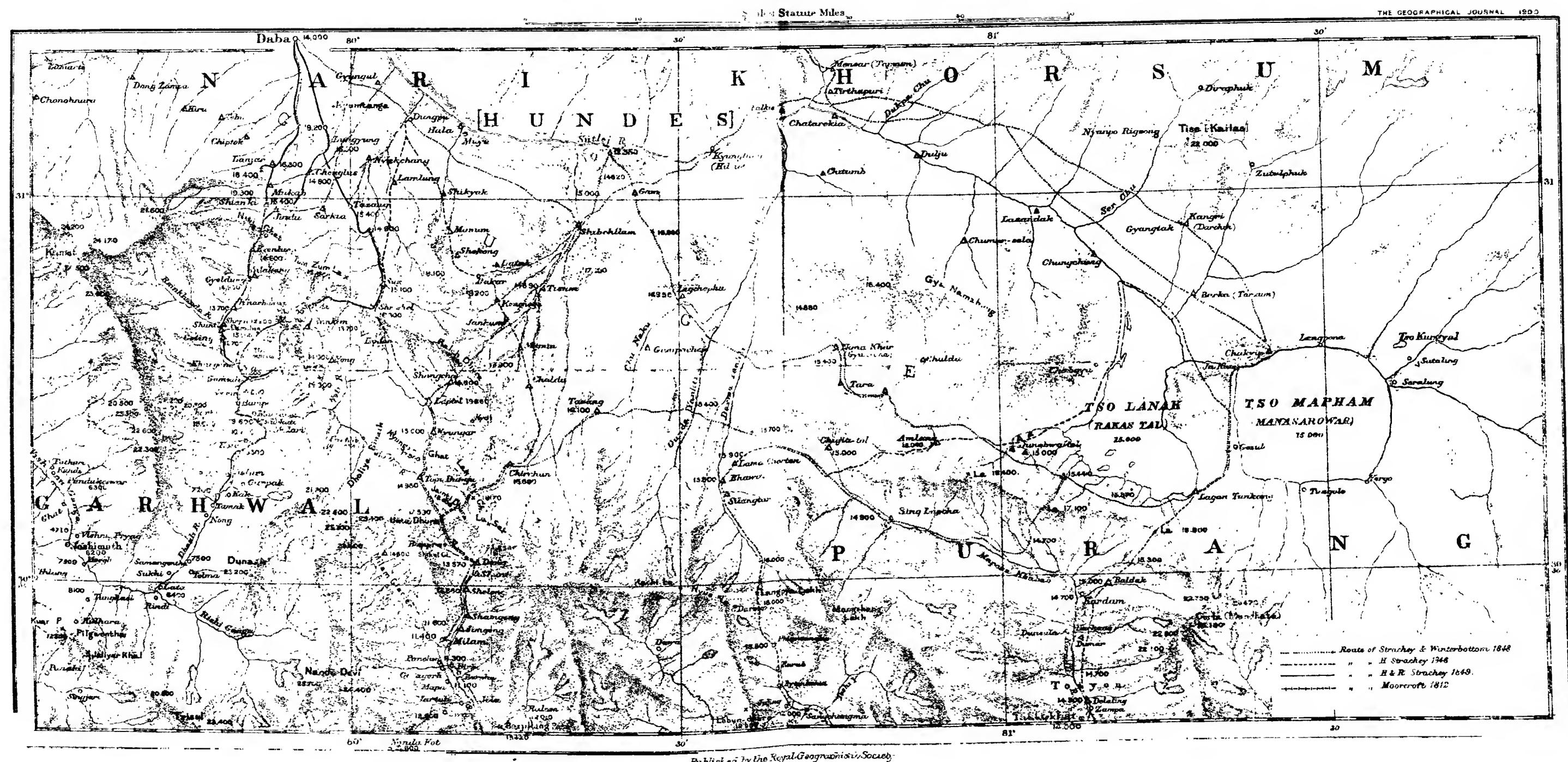
cuts it through caused us to descend to the level of the lake This depression in the ridge between the lakes marks the point where the unconsolidated gravel deposits, over which we had been travelling from Lagan-Tung-kong (the south-eastern corner of the Rakas-tal), give place to the stratified rocks which constitute the projecting headland on the east shore of Rakas-tal, and which are continued across to the cliffs at the north-west corner of Manasarowar. Where we crossed the hollow, which was close to the edge of Manasarowar, there were one or two small pools of water, around which the surface was muddy and covered with an efflorescence of salt. . . . Between this muddy flat and the lake is a raised beach of shingle, its top, I suppose, about six feet above the level of the water of the lake on the one side, and of the muddy flat on the other, between which it forms a complete raised embankment These beaches are, no doubt, mainly produced by the action of the breakers

After having reached the neighbourhood of the outgoing stream, Richard Strachey and Mr Winterbottom went on to examine the place where the stream that flows from the Manasarovar leaves the lake. Approaching Ju (Chiu-gompa), a steep rocky point forced them to ascend. From the height to which we climbed we looked down on the stream that connects Manasarovar and Rakas-tal. The rocks on which we stood formed one flank of the ravine through which it flowed; on its opposite bank was the monastery of Ju The ground at the bottom of the ravine was quite flat, and about on a level with the surface of the lake. A raised beach, which swept in a well-rounded curve along the edge of the lake, was cut through by the effluent stream. This was of no great breadth, and apparently shallow and connected with several pools of still water that looked like old channels. It is strange that Moorcroft, deliberately going to look for the point of efflux, should not have noticed it.

After a quotation from Moorcroft he continues: From this it would seem that he passed over the identical beach I have mentioned, and that he describes the pools of water under the monastery outside of it. The illness from which he tells us he was suffering may have interfered with his powers of observation, but for the rest it must be presumed, that the water in the lake was lower than usual when he passed, or that the bar was higher, so that no water was then actually running over it; and as he walked along the edge of the lake, his eye would have been so near the level of the water that a very small irregularity of the beach might have concealed the course of the stream from his view.

He made a sketch of the outlet and says the eastern lake is of course somewhat higher than the western, but he could not ascertain the difference. From some distance he could trace the hollow through which the stream that connects them runs.¹ As to the hollow or bay about halfway on the western side of the Manasa-

¹ A German, H. Singer, has written a short and rather good article: »Rakas-tal und Manasarowar» (Petermann's Mitteilungen, 46. Band, 1900, p. 166), in which he discusses the diary of Sir Richard Strachey, published in the Geographical Journal 1900. Here, however, we read the surprising reflexion: »Das Tagebuch des Generals beweist nicht das, was es beweisen soll; eher das Gegenteil.» Further he says: »Liest man ferner die Beschreibung, die R. Strachey von dem Ausfluss und dem Thale gibt, und vergleicht damit seine Skizze, so erscheint der Gedanke doch keineswegs völlig ab-



Map of the journeys of H. and R. Strachey, published in 1900.

rovar, he found on his way back that its watershed was almost close to the edge of Rakas-tal and hardly so much as 100 feet above the level of the lakes.

Along the S.E. shore of Rakas-tal he found a great raised beach, at some 200 or 300 yards from the edge of the water and consisting of granitoid detritus. The old beach-lines, which I measured in 1907 he calls a series of steps or parallel roads, situated between the high-water level of the lake and the uppermost of the beaches, which Strachey found to rise above all in a great mound of very remarkable height. He could not help noticing these most strikingly developed features, a consequence, as he believes, of the violent S.W. winds which blow so regularly in the afternoon, and constitute thus a permanently dead lee shore.

As to the fluctuations in the level of Rakas-tal, he comes to the following very clever conclusion worthy of a well-trained observer: There is no evidence available to show whether there is any considerable variation in the level of these lakes from year to year, or from one season to another; but I think that such variations as must have taken place to explain the existence of some of these beaches are hardly compatible with existing conditions, and it is probable that these lakes have been gradually drying up, as seems to be the case in most of the lakes that have been observed in other parts of Western Tibet. In the chapters of this work dealing with my own journey I shall have to return to this question.

He concluded that the Karnali had cut out its deep channel in deposits, continuous with those of the great plateau and caused by the same agencies. From his own and his brother's observations he found it certain that Gurla and most of the highest mountains were chiefly made up of gneiss or mica schist with a comparatively small quantity of granite.

Henry Strachey had discovered the source of the Darma Yankti in 1846. Both at this river and at Gunda Yankti, Richard Strachey came across unmistakable moraines of old glaciers. The interval between two old moraines was precisely on the same level as the great plain, or was actually a part of it, and it hence became evident that the mounds over which he had passed must have been formed along the rivers, and the agency of glaciers readily suggested itself. He thinks the lake basins may in the same way have been cut out by glaciers.

The map accompanying this paper is interesting and gives a good idea of the splendid and, from all points of view, important work of the brothers Strachey (Pl. XII). It gives the routes of Moorcroft, 1812, Henry Strachey 1846, Richard Strachey 1848, and the route of H. and R. Strachey, 1849. As regards the eastern shore of the Manasarovar the map is and must be insufficient. Three rivulets enter the

weisbar, dass es sich nur um einen *zeitweise funktionierenden Abfluss* oder gar vielleicht um einen *früher vorhandenen, aber heute versiegten Abfluss* handelt.» In the first suggestion about a temporary efflux he has found the right solution. The second alternative does not very well agree with R. Strachey's words in the quoted article (Geog. Journ. Vol XV, p. 395): »From the height to which we climbed we looked down on the stream that connects Manasarowar and Rakas-tal.»

north-eastern corner, and one comes from the S.E., but none of them can be identified with the Tage-tsangpo.

Already three years after his return Richard Strachey had written an important article: *On the Physical Geography of the Provinces of Kumáon and Garhwál in the Himálaya Mountains, and of the adjoining parts of Tibet.*¹ There he expresses the following view of the source of the Indus: One of the feeders of the Indus, but not a principal one, likewise takes its rise a little to the N. of these lakes. From his brother he had heard that the main supply of water in the upper part of the Ladak Indus comes from the Sanskar river; the other affluents rise in a much dryer climate and contain by far less water. Moorcroft had made the same observation. J. E. Winterbottom regarded the Shayok as more important than the Ladak Indus.

He gives a beautiful description of the grand landscape round the lakes with the Kailas in the background and as a contrast to the utter desolation of everything.

About the source of the Satlej:² A stream, the head of which we visited, flows from Máñasarowar into Rákás Tál, and the latter occasionally, when high, sends off a feeder into the Sutlej; the main sources of this river, however, are possibly in the streams that fall into it from the Himálaya, 10 or 15 miles to the W. of Rákás Tál.

The nice little map illustrating the paper gives about the same as his brother's map mentioned above, Pl. XI. There are three affluents to the Manasarovar and effluents from both lakes.

Richard Strachey observed the relations between mountain ridges and river courses, and found that the rivers almost universally flow in directions either parallel to the general direction of the chain or perpendicular to it. He distinguishes four different groups of rivers following this law: 1) Those that drain the lower parts of the mountains. 2) Those that rise immediately to the N. of the great peaks, passing between them in channels on the whole perpendicular to the chain, for instance the main affluents of the Ganges, and many of the rivers of Nepal. 3) Those having a considerable portion of their course parallel to the chain, and then suddenly turning to the southward issue from it in a direction at right angles to their upper parts; such are the Satlej and the Chinab. 4) The northern streams, as Indus and Tsangpo. This question has been dealt with by several geographers and geologists in recent years.³

Richard Strachey also gives a good description of the course of the Satlej through the aeolian deposits of Guge and Chumurti.⁴

A year later Richard Strachey went *via* the Marshak pass (18,500) to Rajhote, visited the pass into Tibet called Tumjun-la (16,500) and went down the river

¹ Journal Royal Geographical Society Vol. 21, 1851, p. 57 et seq.

² Ibidem, p. 63.

³ Compare, for instance R. D. Oldham's article: «The evolution of Indian Geography». Geographical Journal, March 1894, Vol. III. p. 169 et seq.

⁴ Jour. Roy. Geo. Soc. 1851, p. 62.

from Raj-hote as far as it was practicable, returning to Niti by the Chor-hoti pass (17,500).¹

One of the objects of this journey was to fix the position of Kailas and Gurla, a work in which he was successful. Thus he was able to continue his survey work of the year before, and the determination of the position of the two peaks augmented the value of Henry Strachey's first rough survey of his route to the Manasarovar.

About the same time Dr. CH. GUTZLAFF's paper *Tibet and Sefan*² was published representing a standpoint of knowledge far inferior to that of the Stracheys. It is somewhat difficult to follow the description he gives of the situation of the sources of the different rivers.³

¹ »Notice of a Trip to the Niti Pass». Journal Asiatic Society of Bengal. Vol. XIX. 1850, p. 80

² Journal Royal Geographical Society. Vol. 20. 1851, p. 191 et seq.

³ »The most remarkable river of Western Tibet is the Ganga. The northern branch rises on Kentaisse mountains, and takes a westerly course through Lahdak for about 80 geographical miles under the name of Latsoo, receiving many small tributaries from the N. Arriving at the Hindoo-cush, where insurmountable mountains oppose its course, it turns S., and then unites with the southern branch, which takes its rise from the Langkok (Langka) lake, in about 30° lat., and runs parallel with the former, above a degree of lat. distant, known under the name of Langtsoo. After the union, the river runs S.W., and, meeting again with high mountains, retraces its course in many windings, until nearly reaching the parallel of its origin. Receiving here the Matsoo as a tributary from the N., it forces its way towards India, and constitutes, perhaps, the chief branch of the Indus. There is no river on the globe which has three parallel turnings like the Ganga. If we refer to the result of researches made only recently, by which the sources of the Indus are said to be on the northern declivity of the branch of the Himalaya mountains, in lat. 31° 20', long. 80° 30' E., and assume this to be the same river that passes Draus in Lahdak, we find some difficulty in reconciling this account with the Chinese maps. The Sutlej is said to issue from the lake Rawansrad, in lat. 31° 46', long. 80° 43'. which would apply to the Langtsoo. The sources of the Matsoo are less known. The above would make three rivers of a stream which the Chinese represent as one. At any rate, very little is yet known with certainty concerning the Ganga.«

»The sources of the Indus are supposed to lie in 31° 20' N. lat., and 80° 30' E. long. If such be the case, the Kang-kö Ganga, after its junction with the Matsoo may possibly turn out to be identical with the Indus. No other large stream here flows towards the S.; and should the latter not be the principal branch of the Indus, the question must naturally arise, what becomes of the immense quantity of water conveyed by the Kang-kö towards the S.? Moorcroft's information upon this point appears to be very correct.«

Regarding the lakes he gives the following information:

»The first station, Gotorpe or Garoo, is a mere encampment, in 31° 8' N. lat., and 80° 24' E. long. The country around is inhabited by nomads. The Mapadalae and Langka lakes, celebrated in Hindoo mythology as Manasarovara and Rawan's-Hrad, are worthy of notice. The sources of the Indus, Ganges, and the Dsangbo, three of the most remarkable rivers in Asia, are here found.«

»To the west are six other lakes, lying in groups of three each, more or less connected by rivers with the Dsangbo. In the S.W. the Tarpoo, Mapama, and Lanken occur, the latter communicating with the Larchoo river.« And further:

»The Mapan (the Manasarowar) is about 14,000 feet above the level of the sea, and is surrounded by frightful mountains. It is a considerable lake, situated in the grandest and most romantic situation, almost constantly kept in motion by gusts of wind that sweep through the mountain-passes. The shores are adorned in the most conspicuous spots with nunneries and convents. From Hindostan numerous pilgrims attempt to reach the spot, under the belief that the sources of the Ganges are here to be found . . . The Langka (Rawan-rhad), N.W. of this, is a much larger sheet of water, which receives in its bosom many mountain streams. A large marsh extends through one of its valleys, and

Dr TH. THOMSON who travelled in the western parts of Himalaya 1847—48 says of the uppermost Indus that it had been less known than any other part in Tibet. But Captain Strachey very much reduced the unknown portion. It rises in the mountains north of the lakes of Mansarawer and Rawan Rhad, and runs in general towards the N. W. Moorcroft has described its appearance at Garu or Gartop, where it is a very insignificant stream; but the intervening country is so little known, except by native report, that we can scarcely be said to have an exact knowledge of the upper part of its course. He is not quite sure of the eastern branch laid down on some maps. From the arid and snowless nature of the country through which it must flow Thomson finds it probable that it is a very small stream, but its length may be considerable.¹

it has a very considerable outlet. Near it is the magnificent Gangdisri, the highest peak of the Kailassa.»

He gives the height of the sacred lake at 14,000 feet, places Rakas-tal to the N. W. of it and makes it much larger and tells the world that the last-mentioned lake has a very considerable outlet, statements which some years before had been proved by H. Strachey to be wrong. Again he returns to the »sources» of the Indus, though he seems to mean the Satlej:

»The source of the Indus are farther west of the Langka lake, which in the Chinese map is joined to the Mapan by an intervening stream. There are no less than five streams which have the claim of giving rise to this celebrated river; one proceeds from the lake itself, and two others stand in connection with its tank-like waters. The northern branch is called Satadra (Satahadra). The Kentaisse mountains pour down rapids both into the lakes and into the infant stream.»

It had been shown by Moorcroft and Henry Strachey that the Satudra is the same river as the one which, at least periodically, proceeds from the lake itself. Lower down on the same page Gutzlaff says that »Keenlung, Dampo, Deba and Toling» are situated on the Satadra. And from Shipki be says the Satadra »receives the name of Satlej.»

¹ Western Himalaya and Tibet; a Narrative of a Journey through the Mountains of Northern India, during the years 1847—8. London 1852, p. 158. But already in the Journal of the Royal Geographical Society for 1830, p. 245, we read of »the Chanthan Gurdokh, or Leh river, the long eastern branch of the Indus.»

CHAPTER XV.

ALEXANDER CUNNINGHAM, THE SCHLAGINTWEITS, AND OTHERS.

In this chapter I have brought together some information about the lakes and their surroundings, dating from the period between the journeys of the Stracheys and the journeys of Montgomerie's Pundits. Most of this information depends upon compilation or reports by natives, and only a few, rather meagre narratives are founded upon autoptic observation.

In his famous book on Ladak,¹ Sir ALEXANDER CUNNINGHAM pays some attention to the region in question. He defines Ngari as embracing the whole of the upper valley of the Satlej from the Manasarovar to the crest of the Porgyal, and he subdivides it into three districts: Gugé, Gangri, and Purang. Curiously enough all his informants agreed that the Garo river was the Singgé-chu or Indus and that the N.E. branch was a mere tributary. By this he places the source of the Indus south of his Gangri range, which, he says, consists chiefly of clay-slate, gneiss and granite.

In chapter IV² he deals with the rivers which spring from the mountains round the Manasarovar: the Indus, Satlej, Gogra and Brahmaputra, or Singge-khabab, the Lion's mouth, Langchen-kha-bab, the elephant's mouth, Macha-kha-bab, the peacock's mouth, and Ta-chhog-kha-bab, the horse's mouth. Ta-chhog is the name of Sakya's steed and means 'the best horse'. The fable of the animals' mouths he explains as being of Indian origin, as the Tibetans know elephants and pea-fowls only by pictures, and because the source of the Brahmaputra, or river of Lhasa, is ascribed to Ta-chhog, the holy steed of Shakya Thubba, or Buddha.

He finds it strange that the question about the real source of the Indus could by some still be regarded as an unsettled point, notwithstanding the distinct and explicit statement of Moorcroft, whose information agreed exactly with that which

¹ *Ladák, physical, statistical, and historical; with notices of the surrounding countries.* London 1854.

² Op. cit. p. 82 et seq.

Cunningham obtained from different people, namely, "that the Garo river is the Singgé-chhu or Indus, and that there is no great eastern branch."¹ We know that this view is a great mistake, for the river of Garo is Garchung or Gartang and the great eastern branch is the Singi-kabab. Cunningham believes that this eastern branch entirely owes its existence to Gerard, who could only account for the two names of Higong-chu and Singgé-chhu by supposing them to belong to different streams. Previous to Moorcroft's travels, he says, an eastern branch had been inserted on the maps, but afterwards Arrowsmith represented it by a dotted line.

He is positive in giving the exact place of the source of the Indus: According to my information, the true source of the Indus lies to the north-west of the holy lakes of Manasarovara and Rawan Hrad, in the south-western slopes of the Gangri or Kailás mountain, in latitude north $31^{\circ} 20'$, and east longitud $80^{\circ} 30'$. Calculating the discharge he also proves that no large stream can join the Garo river above Rānak.

As to the Satlej, whose name in the hills is Satludr or Satrudr, he has the following passage, which proves that he was clear-sighted enough to believe in and understand the important discoveries of the Stracheys:² The rise of the Sutlej in the holy lakes of Manasarovara and Rawan-Hrad has been satisfactorily ascertained by the adventurous journeys of Captain H. Strachey and Lieut. R. Strachey. The most remote sources of the Sutlej are the eastern feeders of the holy lakes, in N. lat. $30^{\circ} 35'$, and E. long. $81^{\circ} 35'$. Numerous small streams flow from all sides into the great lake of Manasarovara, which overflows at its N. W. corner into the lake of Rawan-Hrad. The Tibetan name for the Manasarovar he gives as Tsho-Máphan.³

A splendid map by JOHN WALKER adorns his book. On it the N. E. branch of the Indus is called Senge Khabap or Indus R. which is correct but not in harmony with the text.

ADOLPH and ROBERT SCHLAGINTWEIT reached Ngari-khorsum in 1855. They had no opportunity to proceed to Tibet Proper but gathered much information about it from natives in Sikkim, Nepal, Ladak and Ngari, as well as from British Pundits and French missionaries at Bonga and Tse-jrong.⁴ HERMANN VON SCHLAGINTWEIT tells us that the Pundit (NAIN SING) went to the sources of the Dihong and found that Maryum-la was the watershed between Sutlej-Indus and Dihong. The sources of the Indus he calculates at a height of 16,000 feet on an average. but on his map the N. E. branch is not marked at all, in which he agrees with Cunningham's text,

¹ Op. cit. p. 84.

² Op. cit. p. 128.

³ In »A Gazetteer of the territories under the Government of the East-India Company, London 1857, p. 951, Edward Thornton quotes the description of the source of the Sutlej as given by Cunningham. He also believes that Moorcroft »seems to have approached near to the source, having come upon the Sutoodra or Sutluj.» As to the source of the Indus he says that Moorcroft, Trebeck and Gerard established, beyond any reasonable ground of doubt, that it was situated north of the Kailas Mountains, which is indeed the case.

⁴ Hermann von Schlagintweit: Reisen in Indien und Hochasien. Band II: Hochasien. Jena 1871.

but not with Walker's map. The fall of the Indus he calculates at 16.25 feet per Engl. mile, although he points out the different rate of fall in different sections of the river.

«Gnari-khorsum» or the three dependent districts, he divides into three parts, of which the southern contains the lakes Rakustál, Mansaráur and Tso Kongkyú and runs parallel to the Satlej valley. The second part is crossed by the Indus, and has on its left or southern side a small mountain range, on which the passes Chóko-la and Bóko-la are situated, whereas on the northern side the river is bordered by the mountain range of Chomoráng. The third part is situated between the Chomorang mountains and the Kara-korum. Guge belongs to the Satlej, Purang to the Ganges and Gar to the Indus.

He knows, probably from Nain Sing, that Thókchen is the last station before the Maryum-la and is situated between the Manasarovar and Gunchu-tso on the river Som. The Gunchu-tso, or, as he writes the name, Tso Kongkyú, he calls one of the salt lakes, characteristic for Tibet. The two greater lakes have fresh water and are joined by a river-bed, which, however, is not filled with water the whole year round. Here he goes even too far, for he could have added that in some years there is no water at all in the channel. The Tibetan names for the lakes he finds to be: Tso Mápan or Mapham and Tso Lágnag or Lánag. Further on he seems to have changed his opinion for he says,¹ that in spite of the not insignificant changes of the depth of the lakes in the period of the year, the effluence of water from Manasarovar does not seem to be interrupted, and, quoting Strachey, he says that in high-water times a periodical outflow may exist by which the Satlej would be extended to the lakes.²

At the foot of the Jilkva, a little transverse range,³ which is crossed on the way to Gartok, the Satlej turns more directly west and enters a very great valley which he easily recognises as a former gigantic freshwater lake. Its level was lowered by continued erosion at the place of its outlet and at the same time it was filled by sand, clay and shingle, and so the lake disappeared. In these deposits the Satlej and its tributaries continue to cut down their beds. With this »Guge Lake« he compares the old Kashmir lake which was emptied by the Jhelum. The deposits are horizontal, and of tertiary and diluvial epoch. He estimates these lacustrine deposits at a depth of 1,000 or 1,500 feet, nay, in some places, even at 3,000. Where the Mangnang river joins the Satlej, Adolph Schlagintweit found the depth of erosion to be 1,500 feet. But still the erosion did not go so far down as to the jurassic ground of the former lake basin.

¹ Op. cit. p. 58.

² Lieut. Colonel Torrens is of opinion that the remotest sources of the Satlej are the eastern feeders of Manasarovar, a view that he has got from the reports existing at his time. — Travel in Ladâk, Tartary, and Kashmir, London 1863, p. 17. He has a very poetical description of the birth of the Satlej, p. 18 ibidem.

³ Jerko-la is not a range but a threshold or pass between two ranges.

In July 1855 Adolph and Robert Schlagintweit left Milum in disguise and, only with a few followers, crossed the Kiúngar pass (17,331 feet), which is not in the main range, although the country already proved to have perfect Tibetan character. At Laptel they found fossils of Silur, Trias and Jura. They reached within a few miles of Daba, where they were stopped by Hunias, and so their intention to proceed to the Manasarovar, was frustrated, which was a great pity, for a description of the lakes made by such conscientious and well-trained observers as the Schlagintweits would have been particularly valuable. Between Gyúngul and Míla they crossed the Satlej on a bridge, and they got permission to proceed to the Cháko-la (17,561 feet). So far they succeeded in eluding the watchfulness of the Tibetans, that they managed to proceed some distance beyond the pass. Here Adolph made some sketches and in one of them a part of Rakas-tal is visible as well as parts of the snow-covered range of Kailas and the valley of Gartang. Hermann speaks of the Tise as the principal peak of the Kailas-mountains. Although Adolph and Robert saw and even sketched parts of the Kailas range, this range does not, curiously enough, appear on their map. They then proceeded to Gartok, where they found an absolute height of 15,090 feet.¹

On the map there is no Singi-kabab at all. In the text it is said that the Pundits on their way northwards were the first to settle the three uppermost branches of the Indus: the Sénge Khabáb or Singi-chu with the Lang-chu and the Gártung (Gartang), on the right bank of which Gartok is situated. Of the two first it is said that they are situated south of the Chomoráng range, but north of Gartok, although divided from it by a ridge. Hermann von Schlagintweit is right in saying that the northernmost branch has the greatest amount of water and is the longest of the three and must be regarded as the principal source of the Indus.² He mentions the mistake of Moorcroft who called the Gartang the Indus, and made it rise north of Rakas-tal, without knowing the Jerko-la, which is situated to the N.W. at a considerable distance from the lake and constitutes the watershed between the Indus and the Satlej. And still Moorcroft's map is more correct than that of the Schlagintweits! But we must remember that the map of the Schlagintweits was published in 1861 and as the Pundits discovered the N.E. branch only in 1867, they are perfectly innocent as to the missing head-branch. The text is published in 1871 and therefore sometimes it is not easy to see whether Hermann has got his information from his brothers or from the Pundits.³

¹ The Pundits found it to be 14,240 feet.

² Op. cit. p. 78.

³ Regarding the names of the two lakes he has the following passage: »Manása Saróvara bedeutet: Der See, geschaffen aus seinem (Bráhma's) Geiste; Rákus tal, der See des Rákus, bezieht sich auf einen indischen Helden; dieser See wird auch Ravanrhád, der See des Rávan, genannt, nach einem der Dämonen der Hindú-Mythologie, einst König von Ceylon. Die tibetischen Namen, für die wir jedoch keine Interpretation uns verschaffen konnten, sind Tso Mápan oder Mápham und Tso Lágnag oder Lánag.» Op. cit. Band III, Hochasien: II Tibet, p. 58.

His brothers had heard the name Sénge Khabáb, »descended from the Lion's mouth»; they had also heard the name Singi-chu or Lion River, in which the old Sanscrit word Sinha was better preserved. He thinks this name points to the existence of a very powerful opening of the source, and as the topographical situation corroborates his conclusion, he thinks the Singi-kabab rises from a glacier. Everybody familiar with the hydrography of Tibet would have believed the same, and it is exceptional that this river rises from a rather moderate source; and it is this source which is called Singi-kabab, whereas the river itself is called Singi-kamba. He correctly regards the Singi-branch as the principal river and the Gartang as its tributary.

The mountains N.E. of the sources of the Gartang (Gartung, Gartong or Gar-chung) were estimated at 3,000 or 4,000 feet above the valley. Farther N.W. Adolph and Robert could see the continuation of the Kailas range. On their way back they crossed the Satlej and took the direction of the Mana pass.

In September Adolph went again to Tibet, crossed the Mana pass (18,406 feet) and the Bóko-la (18,450 feet), which the Pundits had estimated at 19,200 feet. On the way back he visited Tholing (12,369 feet), and Cháprang which he found inhabited, only in summer, by some 15 families. The Nélong pass he fixed at 18,320 feet. In Western Tibet we shall have to return to the important results of the Schlagintweits on several occasions.¹

A curious contribution to our problem is given in a paper: *A Trip to Thibet, Kylas, Source of the Sutlej, and the Mansurawur and Rakhas Lakes, by Captain H. U. Smith, I. A.*² Together with Mr A. S. HARRISON, M. A. he started at the end of June 1865 from Nynee Tal and by deceiving the »Tartar guard they succeeded in reaching »Kylas» or rather, the village of Darchin. They found the Manasarovar to be about 15 miles from Darchin, and encamped at the head of the lake under

¹ At about the same time, or 1860, the regions we are discussing, were described in the following words in geographical hand-books: »L'Indus prend sa source dans l'ouest de Tibet, sous le nom de Sing-kha ou Sinh-kha; un de ses principaux affluents, le Setledje, vient aussi du Tibet, presque des mêmes montagnes qui voient naître le Yarou-dzangbo-tchou, et il y porte le nom de Lang-dling; il franchit un défilé de l'Himalaya, pour pénétrer ensuite dans l'Hindoustan.» *Géographie Universelle de Malte-Brun, revue, rectifiée et complètement mise au niveau de l'état actuel des connaissances géographiques par E. Cortambert, Tome III, Paris 1860, p. 226 et seq.*

This passage is perfectly correct. The source of the Satlej and the source of the Brahmaputra are situated in nearly the same mountains. So it was given on d'Anville's Lama-map and so it is described in Chinese texts. And so I found it to be in reality.

Of the sacred lake we read in the same work: »Le plus fameux lac du Tibet est le Mapham-dalai (c'est-à-dire mer non surpassée) appelé par les Hindous Manasarovar; il n'a cependant que 80 kilom. de circuit. Il est formé, au pied de l'Himalaya, par les eaux qui découlent de la montagne neigeuse de Lang-sten-kabab-gang-ri; l'eau en est verte et de bon goût . . . Il est environné de montagnes, excepté vers quatre petites vallées qui s'ouvrent dans la direction des quatre points cardinaux et qui en forment les portes.

The opinion that the lake should be formed by the waters coming down from the Langchen-kabab-gangri, or »Snowy mountains of the source of the Satlej», touches also the real facts. For even if all the other rivers and brooks contribute to feed the lake, the uppermost Satlej or Tage-tsangpo is the principal feeder.

² Proceedings of the Royal Geogr. Society. Vol. XI, 1866—7, p. 119 et seq.

a temple called Jekep. From here they marched about 50 miles to the east and north, of which the two first marches were on the high road to Lhasa. Then they turned to the north and kept under a large range of hills running north and south. From there they returned to the lake for fishing and shooting, after which they travelled by easy marches towards »Gortok«. The author says that their principal object was »to track the course of the Sutluj and see if there were any outlet from the lake northward«. The result of this expedition was negative:

»We carefully skirted both the Mansurwur and Rakhas lakes, and found from the nature of the ground that it was quite impossible that any affluent from either lake could reach the Sutluj, nor was there any trace of an old bed or watercourse, as mentioned in Henry Strachey's paper to the Society regarding his journey in 1846; besides which it would be against the laws of gravity for water to reach the Sutluj from the Rakhas Lake, as it would have to travel a very uphill journey. The Sutluj turns almost at right angles on meeting a small range of hills, and at the nearest point must be fully 12 miles from the Rakhas Lake.«

The travellers took the greatest pains to examine the course of the river, »and traced it step by step till it entered the Kylas range, where we could step across it without wetting the soles of our shoes, besides walking over every inch of the ground from the small range of hills to the Rakhas Tal; and we are both convinced that it is quite impossible there can be any connection between the two, neither is there the slightest trace of any stream or old water-course connecting the Mansurwur and Rakhas lakes: in fact, the Mansurwur Lake is surrounded by a small range of hills, and though fed by many streams from the Kylas range, there is no possibility of any escape (except from evaporation) on the north side of the lake. We took the best evidence procurable, and except in one instance, when the man said he thought that water from the lake might percolate underneath the hill and thus reach the Sutluj, our own ideas were strengthened and substantiated by the opinion of every one we met; in addition to which it was so palpable, that we need hardly have asked any questions.«

The whole paper is little more than 3 pages long and it is rather clever to get in so many mistakes in so short a space. He is no doubt right in saying it would be impossible for the water to escape from the Manasarovar to the north, as from the north a good deal of water runs down to the lake. If the two travellers, and this is mentioned twice, touched only the northern shores, one should in this circumstance find an excuse for their not having found any river-beds, whether dry or wet. But it is positively said, that not the slightest trace of any stream or old water-course connects the two lakes. It makes a very ridiculous impression when sportsmen try to promulgate false information against the statements of the most reliable and careful observers who had ever been at the lakes before, — not for fishing, but for doing geographical work.

Fortunately enough Dr. Thomson was present at the meeting when this paper was read, and he strongly defended the two Stracheys, saying they were men quite capable of recognising a river when they saw it . . . He was sure that Richard and Henry Strachey's observations would be found quite trustworthy, when carefully studied by other observers. To which Captain Smith replied he had no wish whatever to criticise Captain Strachey's observations. He and his friend went out for

shooting. But he reiterated what he had said in his paper, viz. that it was »simply impossible for any water to run from Rakhas lake to reach the Sutluj, for it would have to run up-hill; — he hoped that some other traveller would go and clear the matter up». To this Dr. Thomson repeated that he did not think it at all likely that Major Strachey would be mistaken in his observations. He was well able to judge of the physical contour of a country. The situation was the following: The most reliable experts who had ever been in Tibet, had surveyed the country and given a detailed and scientific description and maps of it. Later on a sportsman goes up to the same country, shooting and fishing, and on his return he turns the geography of the place upside down. When not believed he proposes that somebody else should go and clear the matter up! This is really touching. In our days such papers are not accepted at all in the Royal Geographical Society.

In August 1865 Captain ADRIAN BENNETT paid a short visit to Daba.¹ He entered Tibet by the Chor Hoti Ghaut (18,300 feet). Daba itself has not changed very much since his days. As to the extraordinary morphology of the country round it, he believes that during passed ages the ground has been worn by the action of water into the queer tower-like buildings, which afterwards had been hollowed and inhabited. He easily settles the question about the sources of the Satlej and the Indus, saying: »Both rivers take their rise here; the former from some lakes, and the latter from the hills beyond.» This information was probably given by some native. After a month's stay in Tibet he returned by way of the Niti pass.

Although the journey of THOMAS W. WEBBER belongs to the chapters on the Brahmaputra, I will mention a few words about it here, so far as it comes in contact with the lakes and the Indus. The journey was undertaken in June 1864 and the party consisted of four, the Hon. ROBERT DRUMMOND, B. C. S., HENRY HODGSON, Lieutenant-Colonel SMYTH, and Webber.² Colonel Smyth was an experienced traveller and had made many trips across the frontier into Tibet, and had been over most of the passes. He joined the party for the purpose of getting as far into Tibet as possible. Several times he had tried to get beyond Taklakar, but had always been turned back. In the narrative it is said:³ »Colonel Smyth and Mr Drummond explored a considerable extent of country, the former having marched east and northward over the Mariam La... If this be correct Smyth must have been the first Englishman to cross the Maryum-la. He was the man who selected the young Pundits and sent them to the Engineering College at Roorkee to be trained under the instructions of Colonel Montgomerie. Drummond had visited the Manasarovar in 1860, and had »given great offence» by putting a boat on the lake.⁴

¹ Rough Notes of a visit to Daba, in Thibet, in August, 1865. Proceedings of the Royal Geogr. Society, Vol. X. 1865—66, p. 165 et seq.

² The Forests of Upper India, London 1902.

³ Op. cit. p. 130.

⁴ Sherring tells us that this achievement took place in 1855.

Even with the help of Webber's rather rough map it is impossible to follow their wanderings over »ridge succeeding ridge» in the upper reaches of the Brahmaputra. But the geography becomes still more complicated: »On one occasion we crossed another very lofty divide, and found ourselves suddenly out on the northern slopes of another watershed, none other than that of the mighty Indus. Far beneath us, some miles away, lay the most brilliantly beautiful blue sea, the celebrated Manasarowar lake, as it proved, which we had promised not to approach.» For hundreds of miles to the west range after range could be seen and above them all was the snow-capped summit of the sacred Kailas.¹

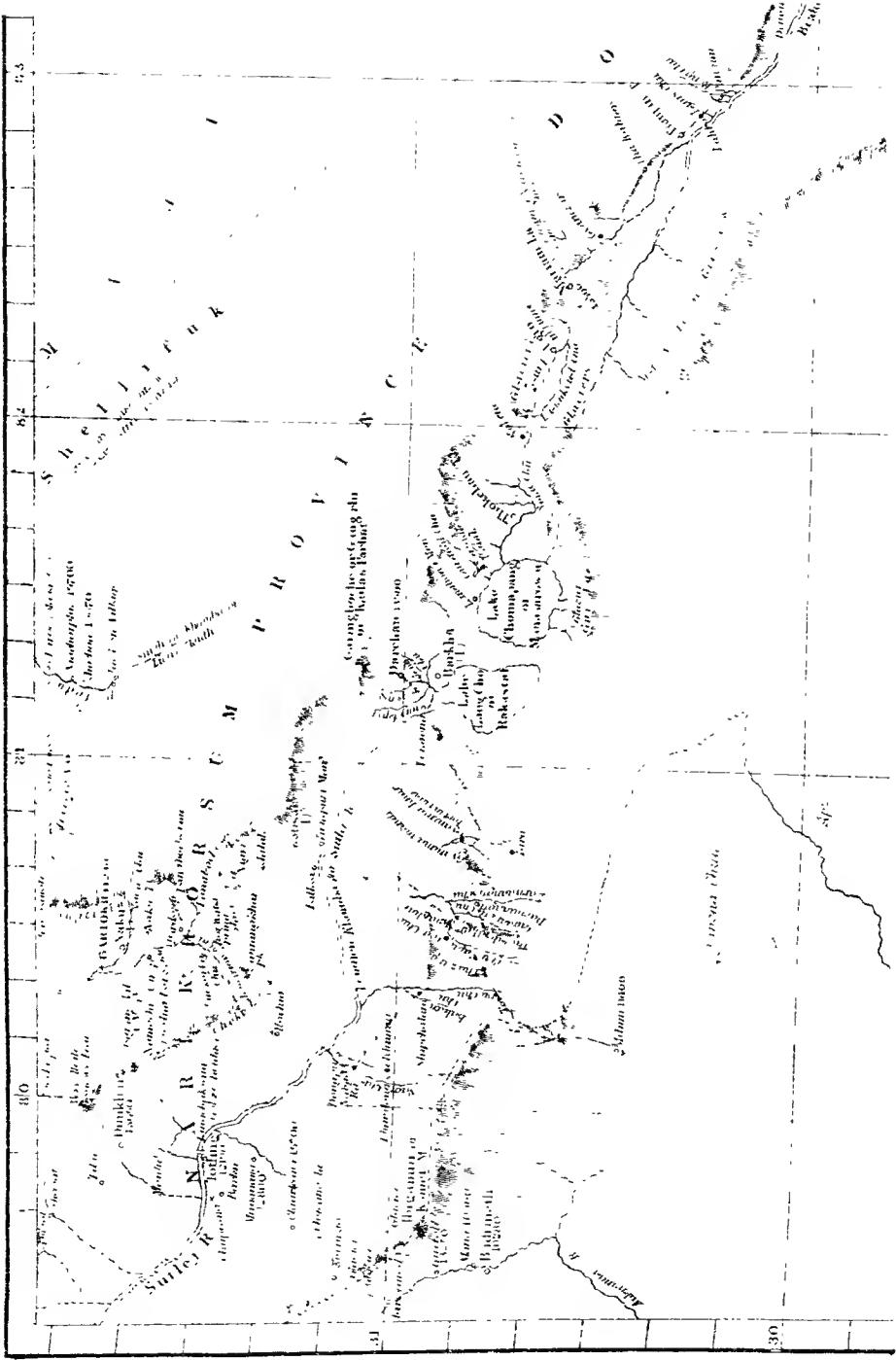
This change of the scenery is really somewhat sudden. We are at the streams going east to the Brahmaputra, and suddenly we cross the watershed of the Indus! It is quite useless to try and explain this situation. On his map he has »Sources of the Indus» between the lakes and Gurla. Thus the watershed of the Indus should be Gurla itself and a range going to the N.E. from Gurla, and then, for some distance following the north bank of the upper Brahmaputra, a range which, so far as its first part is concerned, does not exist. Or, one could think that it was on a separate excursion, perhaps on the way back, that they came to the watershed of the Indus. But this does not help us, as it is said: »Next day we marched a long way eastward along the northern slopes of the Gurla range, following the valley of the Brahmaputra. If we call the Tamlung-la the watershed of the Indus or rather the Satlej, and the tributary Loang-gongo the upper Brahmaputra, we can go in a few minutes from the Indus system to the Brahmaputra system. But then we cannot see the Manasarovar. If you climb a mountain somewhere near, you can see the lake at 50 miles distance, but it is impossible to have the Manasarovar some miles away beneath you the one day and the next to follow the valley of the Brahmaputra.

At the end of his Chapter XI² he sums up his results and mentions amongst other things that he »had ascended very high up on the shoulder of one of the most remarkable mountains in the world, the little-known Gurla Mandhata. This conspicuous mountain might appropriately be called the peak of Asia, as from its glaciers the three great rivers, Indus, Ganges, and Brahmaputra, take their rise.»

In reality, as is well known, not one of these three rivers takes its rise from Gurla-mandata. We may agree to call the whole range to the S.E. from Gurla by the same name as the main peak. And we may even go so far as to reckon the Tage-tsangpo to the Indus, although it properly belongs to the Satlej. Finally we may call the Karnali, instead of the Alaknanda, the source branch of the Ganges. But when we come to the Brahmaputra, we cannot make any more allowances. Webber, however, does by no means call the whole range Gurla. For even on his map, Pl. XVII, the three rivers rise from the very Gurla-mandata itself, and not from its surroundings or continuations. On the S.E. slopes of Mount Gurla he has entered

¹ Op. cit. p. 126.

² Op. cit. p. 133.



Nain Sing's map of the Lakes and the Sources of the great Indian Rivers, 1865—66.

the legend: Sources of the Ganges; on the northern slopes: Sources of the Indus; and on the eastern: Sources of the Brahmaputra». I do not know how this extraordinary map has ever been constructed. The outlines of the lakes are taken, probably, from the Pundit's maps, as they are much better represented than on Strachey's map. The Samo-tsangpo has exactly the same appearance as on Nain Sing's map. There is no channel between the two lakes, although Strachey had found one which Drummond may not have seen. The Satlej is drawn as going out of the Rakas-tal. But not a single rivulet enters this lake from the Gurla. To the Manasarovar, on the other hand, four small rivulets go down from the Gurla. And these are, obviously, meant to be the sources of the Indus. But, as on Webber's map, the Manasarovar has no outlet whatever, it is difficult to understand how these rivulets can ever belong to the Indus. For he cannot know anything about a subterranean outlet and he had no idea of the periodicity of the channel. If he had, the channel should have been entered with a dotted line, or in full as the Satlej, which cannot possibly have gone out of the Rakas-tal without there having been first a communication between the two lakes.

Only the last seven miles of the Tage-tsangpo are entered with a dotted line. If the red line of the travellers' route were entered correctly, they must have crossed the source region of the Tage-tsangpo. But instead of this we find the uppermost Brahmaputra stretching far to the west. It is interesting to notice that so late as 1902 a book and a map were published, teaching the world that the source of the Indus was on the Gurla. And still, 25 years earlier, the Pundits had found out that the Singi-kabab, or source of the Indus, had to be searched for N.E. of Kailas, and some 140 years earlier a Catholic father knew that the Satlej, not the Indus, went out of the Manasarovar.

It is also surprising that such an intelligent and clever man as ROBERT SHAW could write the following words on the source of the Indus, — in spite of all that really was known in 1867 and 1868: »It rises in the mysterious and sacred Lake of Mansorawar, near the source of the great Brahmaputra.« And again, about the Manasarovar, that it is 'one of the sources of the Indus'.¹

¹ Visits to High Tartary, Yarkand, and Kashghar etc. London 1871, p. 70 and 83. Petermann goes so far in the right direction that he even doubts that the source of the Indus can be situated on the Kailas. He finds it more probable that it begins further east. On his map, which is chiefly drawn from J. T. Walker's, Petermann has a channel between the two lakes and the Satlej starting from the Rakas-tal. Petermanns Mitteilungen, 1869, p. 104.

The hydrography of our region was still unclear to scholars in Europe about this time. An article: »Das Setledsch-Thal im Himalaya», by Dr. F. Stoliczka, being an extract from an article published in the Journal of the Asiatic Soc. of Bengal 1868 begins: »Durch die wertvollen Untersuchungen von Moorcroft, Strachey und anderen ausgezeichneten Reisenden ist es bekannt, dass der Setledsch westlich von dem Mansarowar-See entspringt und zunächst die chinesische Provinz Nari (oder Gughi) durchläuft.« Petermanns Mitteilungen, 1870, p. 8. Moorcroft had found that one branch came from the Rakas-tal, and Strachey, that at certain seasons the river perhaps could start from the lake. But as nobody knew how it was in reality, the most convenient way was to say the river had its source west of the Manasarovar.

CHAPTER XVI.

THE PUNDITS OF MONTGOMERIE.

In this chapter we have to consider some of the results of the Pundits so far as they concern our lakes, the upper reaches of the Indus, and surrounding regions of Western Tibet.

In 1861 it was proposed to take advantage of the facility possessed by Asiatics and to employ them on explorations in countries beyond the northern frontier of India which were not accessible for Europeans. The Government of India approved of the project and agreed to support it. Colonel WALKER, the Superintendent of the Survey of India, engaged from one of the upper valleys of the Himalayas two Pundits, British subjects, who were trained for Trans-Himalayan exploration. Their training was completed by Captain T. G. MONTGOMERIE.¹ The instruments they were trained to use were compass, sextant, thermometer, and boiling point thermometer. Distances they calculated by counting their paces for which purpose a rosary was used. The compass they kept hidden in a prayer-wheel, the other instruments in their luggage.

The principal object which was put before the two first Pundits was to define the whole course of the great river known to flow from near the Manasarovar Lake to beyond Lhasa.² Only one point was known on this river, namely, where TURNER had crossed it in 1783.² They were ordered to go to Katmandu and further to the great road between the Manasarovar and Lhasa. Katmandu they reached on March 7th, 1865, but one of them returned from here to British territory. The other, NAIN SING, after many difficulties managed to pass Kirong and reach Tadum (Tradum) where he arrived on September 6th. After his famous visit to Lhasa he was again at Tadum on June 1st, accompanying the Lopchak mission back to the west. He

¹ The title Pundit means generally nothing else than a well educated Hindu, who has read the Hindu sacred books or «shasters».

² T. G. Montgomerie: Report on the Trans-Himalayan Explorations, in connection with the Great Trigonometrical Survey of India, during 1865—7: Route-Survey made by Pundit —, from Nepal to Lhasa, and thence through the upper valley of the Brahmaputra to its Source. Proceedings Royal Geogr. Society, Vol. XII, 1867—68, p. 146 et seq.

crossed the Mariam-La mountains, which were called the watershed between the Brahmaputra and the Sutlej. He returned to British territory by Thájung.

The other Pundit had in the meantime made a route survey of his journey to Gartok. Both reached headquarters of the Survey on October 27th, 1866. The result of the journey was 1200 miles survey, 31 latitudes, 33 heights determined by boiling water, and notes. It was no exaggeration when Montgomerie said this Pundit had performed a feat of which a native of Hindustan, or any other country might well be proud.

Montgomerie summarises in the following words the western part of the johng-lam or tsalam»: it crosses the Kailas range by a very high pass, descends to about 15,000 feet in Ngari Khorsum, the upper basin of the Sutlej, and then coasting along the Rakas Tál, the Manasarowar, and another long lake, rises gradually to the Mariham-la Pass, the watershed between the Sutlej and Brahmaputra, 15,500 (feet). The very high pass mentioned here can only be the Jerko-la, as there is no other pass on the road between Gartok and Rakas-tal. Montgomerie understood that the lakes belonged to the system of the Satlej, although he was mistaken in reckoning the Gunchu-tso to the same system. Maryum-la cannot be said to be the watershed between the Satlej and the Brahmaputra, as the basin of Gunchu-tso, which has no outlet, comes in between the two. And it is interesting to notice that on Nain Sing's own map there is even a low mountain ridge drawn between the «Gunkyud Cho» and the «Some Chu» of the Manasarovar.

Curiously enough, everybody listening to this important paper, to which we shall have to return later on, did not seem quite to have understood the real hydrographical situation. Sir H. RAWLINSON, after the paper, said, talking of the course of the Brahmaputra, that it had been followed down carefully from its source in the Manasarowar Lake to Lhasa, thus putting the problem back a hundred years to the standpoint of Tieffenthaler and forgetting that the Pundit followed the river in the opposite direction. In his address of 1868 MURCHISON speaks still of the extensive plateau beyond the crests of the Himalaya, which stretches west and east from Mount Kailas and the Manasarovar Lake to Lhasa in Great Tibet, and, like Rawlinson, he says the Pundit returned along the banks of the Brahmaputra to the source of that river in the Mansarovar Lake.¹ The two famous presidents do not seem to have realised the existence of one of the most important watersheds in Asia between the Brahmaputra and the Manasarovar. And still the title of Montgomerie's paper, and that of another paper of his: *Report of a Route-Survey made by Pundit* —, from Nepal to Lhasa, and thence through the Upper Valley of the Brahmaputra to its Source,*² clearly enough give a general idea of the situation.

I turn to the part round the lakes as represented on Nain Sing's classical map, Pl. XIII, of his journey in 1865—66, and compiled with admirable skill by Capt.

¹ Proceedings Royal Geogr. Society, Vol. XII, 1867—68, p. 267.

² Journal Royal Geogr. Society, Vol. 38, 1868, p. 129 et seq.

T. G. Montgomerie.¹ The outlines of the lakes are not bad, although the Manasarovar is much better than its western neighbour. The two lakes are called Lake Lang Cho or Rakastal, and Lake Chomapang or Manasarowar. Of the affluents Some Cho is by far the best and very correctly drawn, for Nain Sing's route went along this river, where Thokchan is entered at its right place. Only a little bit of the Tage-tsangpo is to be seen, but nothing of its upper valley which is so important as containing the real and single watershed between the Satlej and the Brahmaputra. South and S. E. of the Manasarovar Gur La is drawn, not as a peak, but as a range, which does not at all correspond to the real configuration of the orography. The range north of the two lakes is much better, but it is a mistake to place Kailas Parbat *on* this range, instead of south of it.² I believe Nain Sing is one of the few travellers who have given the real and correct Tibetan name of this peak, calling it Garingboche, although the spelling is wrong, for it should be Kang-rinpoche. He has also the name Gang-rhi, which, under the form of Gangri, has been the most commonly used in Europe.

Between the two lakes there is no sign of a channel, which, however, does not prove anything, for Nain Sing never went down so far. The Satlej is called Longjon Khamba and drawn with a dotted line. Only the uppermost part of the river, where it leaves the N.W. corner of Rakas-tal, is drawn in full. And this is just the part where Nain Sing's route crossed the river. From this one gets the false impression that there must have been a small effluence.³

Already after his first paper Montgomerie had expressed the following wish: I am trying to extend the explorations northward into the great blank between the Himalayas, Russia, and China Proper; and some day I hope to get a route carried down

¹ Map Showing the Route Survey from Nepal to Lhasa and thence through the Upper Valley of the Brahmaputra made by Pundit — from the Map compiled by Capt. T. G. Montgomerie, R. E. Published for the Journal of the Royal Geographical Society by J. Murray. London 1868.

² In this respect such maps as Berghaus' 1850, Pl. X, and H. Strachey's, 1853, Pl. XI, are more like reality.

³ On the basis of Montgomerie's Report, Dr. A. Petermann worked out an article, to which he added a map (vide Vol. III) on half as big a scale as Montgomerie's original, but containing all its details and some additions, taken from d'Anville, «bei dem im allgemeinen Übereinstimmung mit den neuen Aufnahmen ersichtlich ist und welchem die gestrickelten Theile und Nebenflusse des Brahmaputra entnommen sind». Reisen und Aufnahmen zweier Punditen in Tibet, 1865—66. Petermann's Mitteilungen 1868, p. 233 et seq. For his map he has further used Carte de la route de Tchhing Tou Fou à H' Lassa, 1830, and the map of the Reports on the political Missions to Bootan, etc. The result is admirable, as all the maps compiled by Petermann, and it contains practically everything that was known about southern Tibet in 1868. So far as d'Anville has been used the same mistakes as he makes, return, of course, on Petermann's map. Petermann regards the journey of the Pundit as one of the most wonderful undertakings that has ever ranged in the history of discovery in the interior of Asia. The journeys of Andrade, Desideri, Grueber, Dorville, Huc and Gabet are admirable, but cannot be compared with the achievements of the young Pundit. He means from the point of view of mathematical geography. For, as a describer of humanity and religion, no Pundit has ever approached Huc, and as a describer of the journey itself none of them can ever be compared with Desideri.

On his map Petermann has been careful enough to draw the whole Langchen-kamba with a dotted line, from the very point where it leaves the lake.

the great river from Lhasa to well-known parts of the world.¹ And everybody will agree with Lord STRANGFORD in his appreciation of the sagacity and energy of Montgomerie in conceiving and carrying out such a brilliant scheme as the special education of natives for the purpose of visiting countries inaccessible to Europeans.²

Only a year was to pass before he sent out his next three Pundits. When surveying in Ladak, Montgomerie had himself suspected there was a large eastern branch of the Indus and he was confirmed in his opinion by the surveyors who had sketched the S.E. parts of Ladak.³ He found it desirable to settle the question about the existence or non-existence of this branch, and the clearing up of the question was entrusted to the second expedition of Pundits. It had also to contribute to our knowledge of the upper Satlej, and to survey the route between Gartok and Ladak and to visit the gold-fields east of Gartok. The latter being with a view to gain some knowledge of the vast *terra incognita* lying between the desert of Gobi and Lhasa.

On July 28th the Pundits crossed the Himalaya in the Mana pass (18,570 feet). On August 6th they were at Totling and give a short description of the place. By the Bogola pass (19,220 feet) they crossed the watershed between the Satlej and Indus. Crossing Gugti-la (19,500 feet), they found themselves, on August 14th, on a vast desolate plateau, the lowest points of which they ascertained to be 15,280 feet above the sea. It was called Chojothol (Antelope Plain). By the Pabha-la (17,650 feet), they crossed another range and then descended to the Giachuruff camp, on the banks of the Singh-gi-chu or Indus River (15,730 feet). The headman of the place feared they had introduced Europeans into the country.

On August 22nd, the first and third Pundit left Giachuruff, the third for carrying out a route-survey up the river Indus as far as he could get. The first crossed the Chomorang-la (18,760 feet) and reached Thok-jalung (16,330 feet). The chief was a man from Lhasa. The Pundit heard there was a whole string of gold-fields extending all the way from Lhasa to Rudok along the route which he supposed ran close to the northern watershed of the Brahmaputra, in the depression to the north of it. The gold-fields were said to be carefully watched by the Lhasa authorities, a gold commissioner, called *Sarpon*, superintended the whole of them, and each field had a separate master. He tells us about the gold commissioners' annual tour through the gold district, visiting all the fields and collecting the taxes.⁴ After this trip the first Pundit returned to Giachuruff.

In the meantime the third Pundit had gone up the N. E. Indus branch to Jiachan. On account of the presence of robbers he decided to retrace his steps. "He was very reluctant to do this, as, from all he could hear, 3 or 4 marches more at the

¹ Proceedings Royal Geogr. Society, Vol XII. 1867—68, p. 173.

² Ibidem, p. 166.

³ Report of the Trans-Himalayan Explorations during 1867. Journal Royal Geogr. Society, Vol. 39, 1869, p. 146 et seq.

⁴ This was also the case in 1907 and 1908, as I found.

outside would have taken him to the source of the Indus, which at the farthest point he visited was still a good-sized stream. The robbers seemed to belong to the nomadic inhabitants of the Shellifuk (Selipuk) and Majin districts, who were noted as professional robbers.

After his return, on September 4th, the whole party left Giachuruff and went down the Indus. On September 12th they reached the junction of the Indus and Gartok rivers. Quite correctly the Pundits regarded the eastern branch as the head river.¹

From the junction the third Pundit went to Demchok and the Ladak frontier, and the first, Nain Sing, to Gartok. As to this name he found it to be a corruption of Gártod or upper Gar, but it was also called Gár-Yársá from *yársá* summer and *sá* abode. The lower place was called Gár-Gunsá, from *gunga* winter, and *sá* abode.

Over Totling they returned to Badrinath, after 18,000 square miles survey; 850 miles route-survey, 80 heights and 75 latitudes. From Totling to Shipki the route had not been surveyed before. Montgomerie summons up the important results of this expedition as follows:²

»The routes have also defined the courses of both the upper branches of the River Indus from near their sources to their junction, and the conjoint stream from that point into Ladak. Neither of these branches had been previously surveyed in any way, except a small portion of the Gartok branch above Gartok, which had been roughly laid down by Moorcroft. — The existence of the eastern branch was doubted by many geographers, as no Europeans had ever seen it.³ The Pundit's route has now proved that this eastern branch is the main stream known to the natives as Singh-gi-Chu or Singh-gi-Khamba (Lion's mouth), the River Indus itself, whilst the other branch, hitherto generally supposed to have been the main stream, is much smaller than the eastern one, and invariably called the Garjung-Chu.⁴ — A number of lofty snowy peaks were determined from various stations of the route-survey, the most remarkable being the Aling-Gangri group north of the Indus, which, judging from the great mass of snow seen on the southern face during August and September, must be upwards of 23,000 feet above the sea, possibly as much as 24,000 feet. The Aling-Gangri group had never, as far as I am aware, been heard of before. They appear to be a continuation of the range between the Indus and the Pangkong Lake. The Pundit could see no farther continuation of the range to the East of Thok-jalung. — The Pundits crossed the great range between the Satlej and the Indus three times, that between Gartok and Chajothol once, between Chajothol and Giachuruff once, the Chomorang Range twice, and the Himalaya Range three times, each of the crossings involving a pass of over 17,000 feet, two of them being over 19,000 feet.»

As to the real source of the Indus Montgomerie makes the following interesting reflections, showing that he felt inclined to let the Indus rise from Kailas, although he found it more probable that it came from a place farther east.⁵

¹ After this trip no traveller went to the upper Indus, and the »3 or 4 marches» to the source were still left unknown when I succeeded in reaching the Singi-kabab, or source of the Indus in 1907.

² Loc. cit. p. 158.

³ Only Henry Strachey had, from native information, indicated it on his map.

⁴ This view is the only correct one. By direct measurement I found in 1907 that the Singi-kamba, coming from Singi-kabab was considerably greater than the branch from Gartok. See lower down.

⁵ Loc. cit. p. 160.

»The actual source of the eastern branch or main stream of the Indus was not reached, but the people between Giachuruff and Jiachan said it rose at a place called Gangri-Goorgiap, which may perhaps refer to the Gangri or Kailas Peak; but the direction of the course of the Indus, as seen from near Jiachan, pointed rather to the east of that mountain. The whole district along the upper course of the Indus is called Bongthol, which is divided into the small districts of the Singhtod and Singhmet, 'tod' signifying upper, and 'met' lower. At the highest point visited the Indus was still a considerable stream. At Giachuruff the ford was always a difficult one, and for eight days after the fall of snow the Pundit experienced, the river was not fordable in any way. — From Jiachan to Giachuruff the Indus flows through a rather broad, flat valley, and from Giachuruff to its junction with the Garjung-Chu it flows through a similar valley, the banks being lined in many places with long patches of low jungle. The Indus above the junction was from 100 to 200 paces in breadth, with a depth of 4 to 6 feet; while the Garjung-Chu was in places as much as 250 paces in width, but with a depth of only 1 to 2 feet. The Garjung-Chu between Gartok and the junction flows through a particularly broad and flat valley. The Indus below the junction flows through a wide valley to a considerable distance below Demchok.»

Montgomerie almost always gets the right grasp of the countries from which his Pundits have brought home reports, and he describes them as if he had seen them with his own eyes. The following passage is of particular interest, for, so far as I know, it contains the only information we possessed of the district of Selipuk, until I was fortunate enough to visit this place 40 years later:¹ When at Thok-Jalung the Pundit made diligent inquiry as to the adjacent countries; he was informed that a large district, called Majin, extended for nine days' journey to the east, and that a smaller district, called Shellifuk, lay to the S.E. The Majin country was said to be a difficult one to travel in, as no rivers ran through it. The Shellifuk district boasted of some streams, but they all run into a large inland lake. This lake was Nganglaring-tso.

The Pundit found that north of Thok-jalung the country was not regularly inhabited; only thieves called Champus or Khampus were said to live there, information that was somewhat exaggerated. From Thok-jalung a direct road was said to go in a S.E. direction to Tadum (Tradum) and it was said to cross some comparatively low ranges, but generally to run over plains.

The new information brought back by the Pundits from their journey of 1867 induced Major Montgomerie to send the third Pundit upon a new expedition, the preparations for which were made early in 1868, and the object of which was to explore the country beyond the eastern watershed of the upper Indus.² The Pundits of 1867 had got some information about the country between Rudok and Thok-jalung and between the latter place and Tradum. Further they had heard of an »upper road from Thok-jalung through various gold-fields to Tengri-nor and Lhasa. They had even met merchants who had travelled that road. It is characteristic for Mont-

¹ Loc. cit. p. 161.

² Narrative report of the Trans-Himalayan Explorations made during 1868 . . . Journal Asiatic Society of Bengal. Vol. XXXIX, Part II, 1870, p. 47 et seq.

gomerie that he continues upon the ground of every new piece of information he gets. By intuition he uses even vague and uncertain news and makes the best use of them. Now, going upon the above information, he sent his next expedition of 1868 from Spiti over Chumurti to Demchok, where, in July, the Indus was found to have a breadth of 270 feet, a depth of 5 feet, and a velocity of 2³ 10 miles an hour. Over Rooksum the party went eastward through Rawung and Tingche to Dak-korkor. Rudok was also touched by the Pundit's route. Henry Strachey had reached 12 miles east of the place and GODWIN AUSTEN 12 miles north of it. On the way from Rudok to Thok-jalung the Pundit saw no high peaks to the north or east, a circumstance which persuades Montgomerie to believe in the existence of a large plain in that direction, so much the more as Chang-tang means «The Great Plain». ¹ Nowadays we know that there is in reality very little of a plain. The word, moreover, means «The Northern Plain».

In his instructions the Pundit was told to proceed, if possible, along »the upper road« ² to Tengri-nor and Lhasa, or, failing that, to take the road through Majin and Shellifuk» to Tradum.

About 20 miles north of the Aling Gangri a place called Dak-korkor was reached by the third Pundit. This place is situated on the right bank of the Aling-chu River, which goes eastwards and falls into a salt lake, Hagong-cho, which, formerly, had been more extensive. He also passed the famous salt lake Chak-chaka, which he describes as being all but connected with the Hagong-tso, and he says that an area of about 20 miles by 10 is all about on a level with those lakes. This space is said to be filled with salt, which at one time evidently had been covered with water. The same phenomenon is, as I found in 1901, very common with many other lakes in Western Tibet.

The same Pundit first heard of a gold-mine Thok-daurakpa, which was said to have a separate *Ser-pun*. It was said to be the chief place in a district called Jung Phaiyu-Pooyu, from where a large river was said to flow northwards and then eastwards towards China. The name of the district also belonged to some high snowy peaks which were supposed to be those at the eastern end of the Kwen-lun range. ³ Due north from here was said to be the country of Whor or Hor, which Montgomerie supposes to be the Tibetan name for Eastern Turkestan.

The projected journey to Tengri-nor could not be carried out this time. From Thok-jalung the party went through the Majin country, »partly undulating, and partly quite level, but all about the same altitude, viz. 15,000 to 16,000 feet above the sea. The drainage sloped towards the east, and nothing but comparatively low rounded hills were visible in that direction; whilst on the west

¹ Montgomerie: Report of the Trans-Himalayan Explorations made during 1868. Proceedings Royal Geogr. Society, Vol. XIV, 1869—70, p. 207 et seq.

² I. e. the Ser-lam, or gold road in Bongba, which I crossed later on.

³ J. A. Soc. Bengal, loc. cit. p. 50.

the party skirted a large plain of a yellowish colour, said to be drained by the Upper Indus.»

Several lakes producing salt and borax were passed, and after 9 days to the S.E. they reached Kinglo, a place on the river Chu-sangpo, which was so large that it could not be forded during the summer. »This river flows eastward and falls into the lake called Nala-Ring-cho, or Cho-Sildu, said to be about the same size as the Mansarovar Lake; it has a small island in the centre. The lake is reported to receive a large stream from the south, another from the east, and a third from the north, the latter draining part of the Phaiyu-Pooyu district. The lake is said to have no exit . . . Then the party went S.W. to the Manasarovar. They followed the course of the Sangpo-chu (Chu-sangpo) nearly to its source, crossing one very high range called Nakchail, and another called Riego and finally descending to the Lake Mansarovar. The Nakchail and Riego ranges are evidently off-shoots of the Kailas peak.»¹

The Pundit heard that south of the lake was a well-known monastery called Shellifuk, the residence of a great Lama. Still farther south there are some high snowy peaks and the district Roonjor. North are the districts Gyachun and Girke, of which the latter was supposed to adjoin Phaiyu-Pooyu.

This passage is both important and interesting. To begin with, it proves that the Pundits never succeeded in going to Nganglaring-tso and Selipuk-gompa, and that no traveller had ever reached these places before I visited them in 1908. The Pundit's Chu-sangpo must be the Aong-tsangpo, in its lower part, and after the junction with Lavar-tsangpo it keeps the name of the last-mentioned river. The natives exaggerated when saying the Nganglaring-tso was the same size as the Manasarovar, for it is considerably smaller. There is not one, but several islands in the lake. The river reported to enter the lake from the south must be the Sumdang-tsangpo. The way back to the S.W. cannot have been very far west of mine in 1908; here they followed the Chu-sangpo and then crossed one very high range and then another range, probably less high. But it cannot be the same route as mine, for the names they give are Nakchail and Riego, whereas mine were Ding-la and Surnge-la, which were known all over this part of Tibet. On my road I never met any native who had heard the names Nakchail and Riego, which of course does not prove that they do not exist. Nobody would ever think of calling the two ranges in which Ding-la and Surnge-la are situated off-shoots of the Kailas peak. And wherever the mountains crossed by the Pundits are situated, they cannot have anything to do with the Kailas, which is south of the Transhimalaya.

At the Manasarovar, where the party arrived in safety, the Pundit decided to wait for a caravan for Ladak, which was known to be on its way. In the meantime the third Pundit mapped carefully the Manasarovar, during which he made the important

¹ Journ. As. Soc. Bengal, loc. cit. p. 54, and Proceed. R. G. Soc., loc. cit. p. 210.

discovery that »though the water was sweet no exit was seen: at one point on the west the ground near the Ju monastery was low, and looked as if water had perhaps at one time flowed through, towards the Rakas Tal lake, though it is now too much above the lake to admit of it.»¹

Here we have a perfectly reliable statement, that in 1868 there was no communication between the two lakes. But the Pundit observed the channel and saw there had been communication before. This may have happened only the year, or a few months before. It very much depends also on the season, at which the Pundits were there.

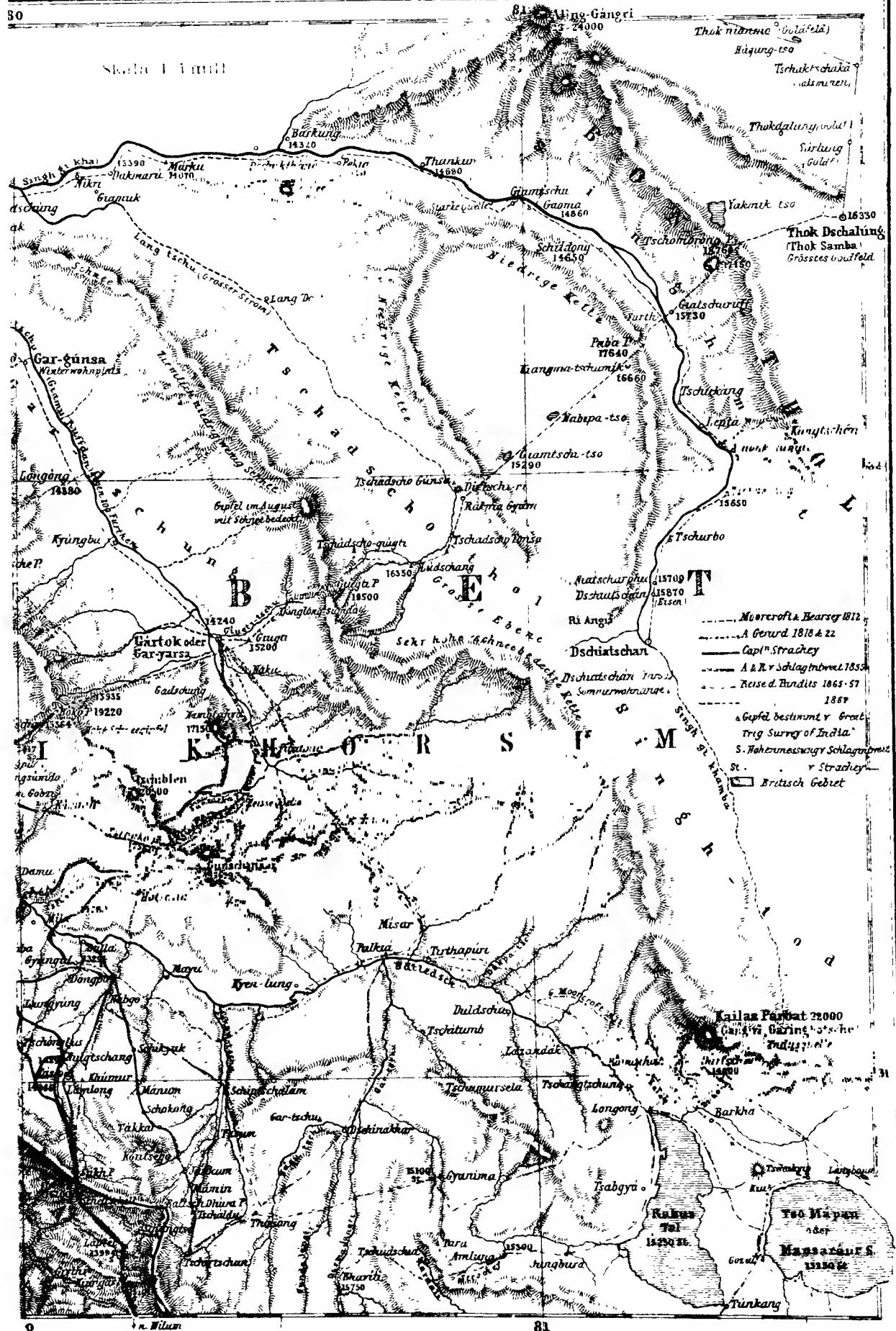
Although the expressions: the Pundit, the chief Pundit, the 3rd Pundit, the servant of the Pundit, the agent of the chief Pundit, the 1st and 2nd Pundit, cause some confusion when we try to follow the red line of the journey, it is sure that the »Pundit made his way along the great road to Shigatse, where he was stopped. »Whilst marching between the Manasarovar and Shigatse he was able to take bearings to various peaks north and south of the road, which no doubt will add considerably to our knowledge of the mountains on either side of that route» . . . So far as the northern mountains were concerned this hope was never fulfilled. The return journey touched Tradum, Liktse and Lohtod, »four or five miles south of the Himalayan watershed». The ascent up to the watershed was found to be very slight. It could hardly be called a pass. He is right in this, for the pass is Kore-la, which is only some 300 feet above the Tsangpo, and which he calls Photu-la (15,080 feet).

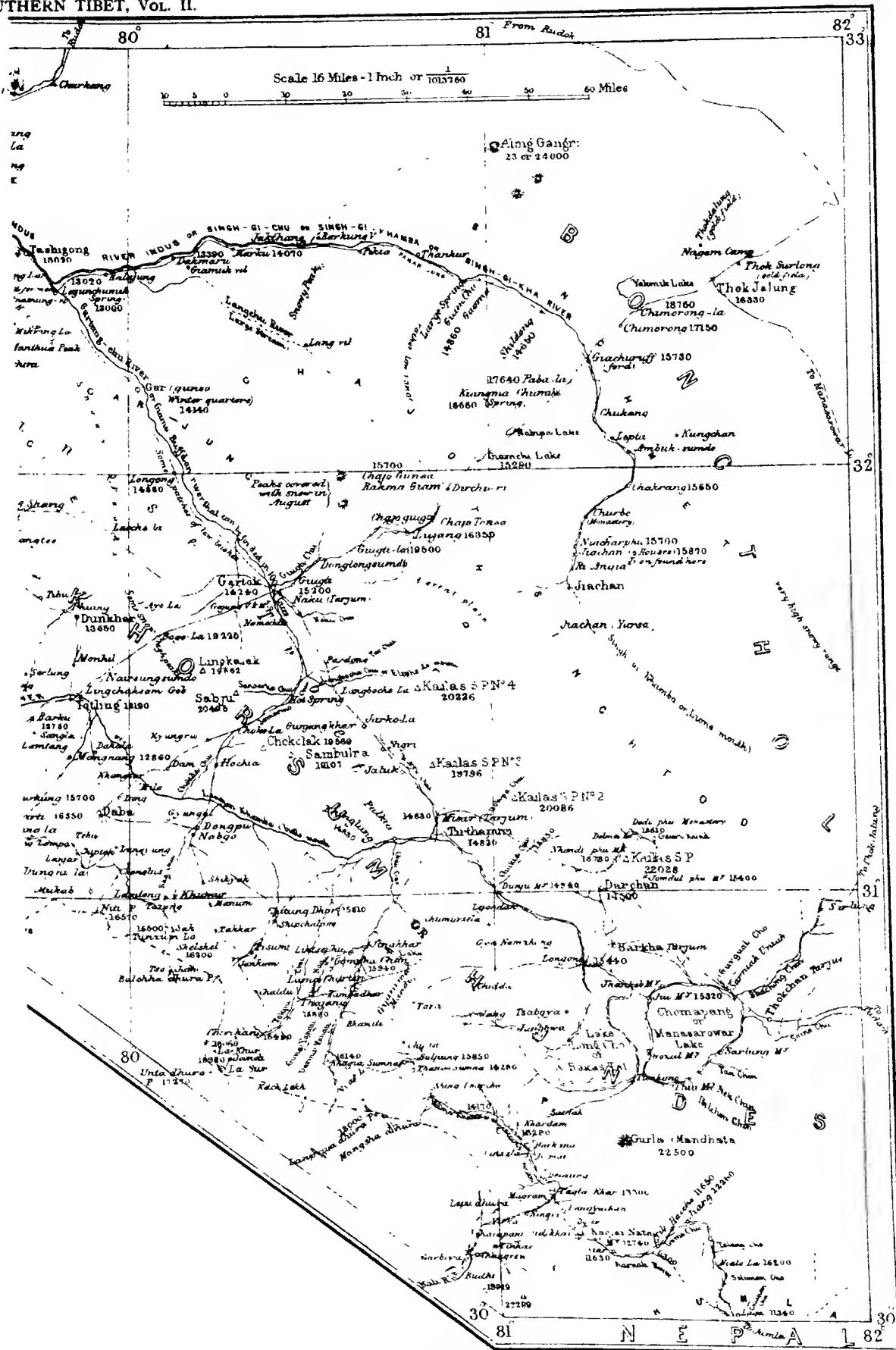
In his report, Dehra Dun, November 1872, T. G. Montgomerie tells us that his explorers, from the Panggong, had extended the survey-line by a traverse to Rudok, and thence, over the very elevated plateau north of the great Aling-gangri peaks, to the Thok-jalung gold field, passing through a succession of gold and borax fields. From Thok-jalung the line was extended S.E. through Májin to the Shellifuk lake, N.E. of Kailas over the most elevated plateau in the world. This portion of the outer line had thus been connected with lake Mánsarovar. Further extensions had been made to the west and north of Lhásá, and Montgomerie trusted eventually that a junction would be effected between this and the portion near Selipuk and thus open out a large portion of the geography of Central Tibet.² From this one gets the impression of a survey to the very neighbourhood of the Nganglaring-tso though I have not been able to find any detailed report of its results. I never heard the name Májin near Selipuk, but it may be the same as Yumba-matsen.³

¹ J. As. Soc. Bengal, loc. cit. p. 56, and Proc. R. G. S. loc. cit. p. 211.

² General Report of the Great Trigonometrical Survey of India, 1871—72, p. 19.

³ In an article: »Das Quellgebiet des Indus und Satledsch», Petermann's Mitteilungen, Band 17, 1871, p. 434, FR. HANEMANN gives a general view of the results of the Pundits. His map illustrating his paper — or the paper is rather an explanation to the map, — is excellent. It embraces only Ngari-khorsum and small parts of the adjacent country. It is based upon Montgomerie's map: Upper basins of the Indus and Sutlej Rivers with sources of the Brahmaputra and Kurnali Rivers, from route surveys made by the Pundit explorers, compiled from the original materials by Captain T. G. Montgomerie, G. T. S. of India, — and Map of the Punjab, Western Himalaya, and adjoining parts of





Part of G. W. E. Atkinson's Gazetteer Map of Kumaun and Hundes, 1875.

By the order of Colonel J. T. Walker, Mr. G. W. E. ATKINSON prepared, in 1875, a very good *Gazetteer Map of Kumaun and Hundes*, Pl. XV.¹ The lakes are here better than in any other map of the time, although the islands in Rakas-tal are missing. This lake is called in Tibetan, Long Cho, and the sacred lake Chomapang. Five of the eight monasteries are entered, and called Jiu, Gozul, Thui, Sarlung and Jhankeb. The river Rilchen Chin of the map is my Ri-chung-chu, the Nek Chin is Nima-pendi, the Tak Chin is Tage-tsangpo, the Some Chu is Samo-tsangpo or Samo-chu, the Bhachong Chin is Pachung-chu. Thus almost all the really existing rivers are very correctly laid out, which is the result of the Pundits in 1868. The route between Thok-jalung and the Manasarovar follows the valley of Pachung and crosses a pass called Sar-lung. As my route over Surnge-la follows a more easterly river, it is obvious that there are two parallel roads over the mountains in these regions. There is no connection between the two lakes, for there was none at the time of the visit of the Pundits. But still the Satlej is shown as issuing from the Rakas-tal, for we have seen that Nain Sing in 1866 had represented it so; however, it must have been a mistake.²

Tibet from recent surveys, and based upon the Trig. Sur. of India & by John Walker. Other material was found in Gerard's, Lloyd's, Moorcroft's, and Hearsay's accounts, as well as from Strachey and Schlagintweit. Pl. XIV is a reproduction of the eastern part of Hanemann's map.

The three feeders of the Indus are marked out as they have since remained on all European maps, until I visited the region round the source of the principal branch. This, the north-eastern branch, is on Hanemann's map correctly called Indus, Singh-gi-tschu, Singh-gi-khamba or Singh-gi-kha. The part of it, above Dschiatschan (Jiachan), the uppermost point of the Pundit of 1867, is also called Singh-gi-khamba and shown by a dotted line, in the district of Singh-tod. This dotted line cannot be expected to be anything but incorrect and the source is placed on the eastern slopes of the Kailas Parbát, Gang-ri or Garingbotsché, where we even read the word: Indusquelle. Below Dschiatschan we find the very sharply drawn range, the highest summit of which is Aling-Gángri. On and along it are the two names Bong-thol and Singhmet. Between this branch of the Indus and the Lang-tsчу (»Grosser Strom«) are two »Low ranges«, crossed by the route of the Pundits. In a following part of this work I shall have to return to them and to compare my results with those of the Pundits. Between Lang-tschu and Gartung-tschu is a range, starting from the Kailas and running north-west. On its first half, from Kailas, we read: »Sehr hohe schneebedeckte Kette«, on the latter half: »Ziemlich niedrig, wenig Schnee«. The region round the sources of the Satlej is taken from Strachey, the Pundits and Moorcroft. There is no channel between the two lakes, but the lower half of it, the western, is marked out as a little rivulet to Rakas-tal. From Rakas-tal the Satlej goes out, and this is regarded as the source branch of the river, carrying the name Satledsch, which is correct, regarding the situation of the valley, the Satlej of Guge being in a straight line with the valley of the river of the lake, whereas Darma Yankti enters the Satlej at right angles. The routes of Moorcroft and Hearsay, A. Gerard, the Stracheys and the Schlagintweits and finally the Pundits of 1865—67 are all entered which adds immensely to the value of this map. — In an article, »Le Tibet», Vivien de Saint-Martin reviews the results of the journey of Montgomerie's Pundits 1865—67. Of the western regions and the surroundings of Manasarovar he says: »Toute cette région du Tibet, où sont les sources de toutes les grandes rivières de l'Inde, le Brahmaputra, le Sindh, le Satledj, la Yamounâ et le Gange, est un plateau montagneux de 4 à 5,000 mètres d'élévation au-dessus du niveau de la mer.» — L'année géographique. Revue annuelle des voyages etc. Septième année (1868), Paris 1869, p. 119.

¹ In Edwin T. Atkinson's: The Himalayan Districts of the North-Western Provinces of India, 1882—86.

² On the maps in Richthofen's China, I, Berlin 1877, there is the channel from the Manasarovar to Rakas-tal and the Satlej issuing from the latter.

The road of the pilgrims round the Kailas peak is also very good indeed, proving that the Pundits here have carried out a very useful and valuable survey. The map gives the names of Nhendi-phu, Dedi-phu and Jomdul-phu, which I have spelt: Nyandi-gompa, Diri-pu-gompa and Tsumtul-pu-gompa on my map. It also gives Dolma La and Gauri Kund, for which I have preferred the Tibetan name: Tso-kavala.

Atkinson's map is more careful than HANEMANN's in putting in the source of the Indus. The uppermost course of the river is hardly marked out beyond Jiachan (Yarsa) and the legend: »Singh-gi-Khamba or (Lions mouth)» points in a more correct direction than on Hanemann's map, where we found the upper part of the river placed at the eastern slope of the Kailas. Otherwise Hanemann has got a great deal of his information from this very map. The Lang-chu river, which was regarded as one of the three source branches of the Indus, was also discovered by the Pundits.

On Montgomerie's excellent map, 1875, to the exploration of the native explorers,¹ we find the bed of the Satlej from Rakas-tal as a dotted line, but no communication between the two lakes, although the Stracheys had seen the stream in 1846 and 1848. So obviously the channel was dry when the Pundits brought information to Montgomerie.²

The range south of Tso-mavang and Guncho-tso is very incorrect. But it was seen only from some distance as were also the northern mountains. »Singh-gi Khamba or Lion's Mouth» is given in a dotted line S.E. of Jiachan. There is no room for Tage-tsangpo. The Brahmaputra has got two sources: 1) Mariam-la; 2) the southern source which starts from 82° E. L., i. e. the meridian of the western end of Gunchu-tso, and coming from some mysterious glaciers. The rest is just as on the map illustrating Nain Sing's journey 1865—66.

The following description of the Manasarovar was given in 1886 by W. W. HUNTER:³

»Máñasarowar (Máñasa-sarovara), Lake in Tibetan territory beyond the great southern wall of the Himálayas, in about 30° 8' N. lat., and 81° 53' E. long. Máñasarowar lies to the south of the sacred Kailás mountain, and, like that celebrated peak, occupies an important place in Hindu mythology. The *Varju Purána* relates that when the ocean fell from heaven upon Mount Meru, it ran four times round the mountain, there it divided into four rivers which ran down the mountain, and formed four great lakes — Arunoda on the east, Siloda on the west, Mahábhadra on the north, and Mánasa on the south. This legend may dimly represent the

¹ Journal Royal Geographical Society, Vol. 45, 1875, p. 299.

² In 1870 Trelawny Saunders expressed the following opinion about the source of the Satlej: The Sutlej rises at the northern base of the Himalaya, in the great lakes named Manasarowar and Rakas-tal 15,200 feet high The water-parting of the Indus reaches the probable source of the main stream in the sacred peak of Kailas Parbat, called also by the pundit 'Gang-ri'; and continues along the Gang-dis-ri mountains, which now skirt the Sutlej as far as the sacred lakes of Rakas Tal and Manasarowar, where the Sutlej rises The Sanpu rises close to the sources of the Indus and Sutlej at a height of 16,000 feet. A sketch of the Mountains and river basins of India, London 1870, p. 6 and 29.

³ The Imperial Gazetteer of India, London 1886. Vol. IX, p. 276.

fact that the Kailás mountain forms a great water-parting to the north of the southern range of the Himálayas. The Indus starts eastward from its northern slope; the Sutlej takes off to the south-west from its southern side, and the Sanpu, or Brahmaputra, flows eastwards from its eastern base. The Sanskrit mythologists believed that the Ganges issued from the sacred lake Mánasarowar Geographers held that the Sutlej took its rise in the lake, but the true origin of that river is ascribed by Moorcroft to the Rávama-hráda lake, close to the west of the Mánasarowar, and perhaps connected with it.»

So late as in 1886 the Kailas could still be regarded as a great water-parting, though the journeys of the Pundits ought to have taught better. The journey of the Pundit in 1867 to the upper Indus had brought no more light regarding the source of that river, than that it could be supposed to flow eastward from the Kailas, instead of westward from the northern side of the Transhimalaya, the existence of which, even here in the west, was very little known. It is hardly possible to be more distant from the solution of a geographical problem! The brooks rising from the southern side of the Kailas go to Rakas-tal, and it is hard to see why they should be called the source of the Satlej.¹ As to the source of the Tsangpo it is curious that, twenty years after Nain Sing's journey anybody could place it at the eastern base of the Kailas. Hardly anywhere have the fantasies of geographers taken such liberties as in the country round Kailas and the Manasarovar. Almost every new writer has a new sort of geography. The only map which has kept its ground through the storms of nearly two centuries is D'ANVILLE's.

¹ A few years earlier another compilator, Dr K. GANZENMÜLLER, had a far more correct understanding of the hydrography, in saying: »Der Satledsch nimmt seinen Ursprung in den Seen Mansarovar und Rakus-tal.« *Tibet nach den Resultaten Geographischer Forschungen früherer und neuester Zeit*, Stuttgart 1878, p. 42.

CHAPTER XVII.

KAWAGUCHI.

I now come to a very wonderful and interesting — and amusing narrative of a journey in Tibet, accomplished by the SHRAMANA EKAI KAWAGUCHI.¹ He left Japan for Tibet in June 1897 and returned to Japan in May 1903. His object was to study the sacred texts of the Holy Religion and to compare Chinese versions of Buddhist texts with Tibetan. After having met SARAT CHANDRA DAS in Darjeeling, he visited Buddhagaya in January 1899, went back to Calcutta and thence to Nepal and Katmandu, where he made up his mind to visit the Manasarovar and Kailas. »Fortunately a good pretext was at hand for me. For I happened to think of the identity of the lake Manasarovara with the Anavatapta Lake that often occurs in the Buddhist texts. However divided the scholastic views are about this identity, it is popularly accepted, and that was enough for my purpose. The identity granted, it could be argued that Mount Kailasa, by the side of the lake, was nature's Mandala, sacred to the memory of the Buddha, which formed an important station for Buddhist pilgrims. So one day I said to my host: 'Having come thus far, I should always regret a rare opportunity lost, were I to make a stork's journey from here to Lhasa, and thence to China. The Chinese text speaks of Mount Kailasa (Tib. Kang Rinpo Che) rising high on the shore of lake Manasarovara (Tib. Maphamyumtsho). I want to visit that sacred mountain on my way home . . .' »²

We may read all the European visitors' accounts without once finding the real and correct name for one of the most famous mountains on the earth. But as soon as an Asiatic goes there he finds it out at once and calls it correctly Kang Rinpo Che.³ If that had been done in due time, the unfortunate name Gangri would never have been introduced on European maps, for every ice-mountain is a Gangri or Kang-ri just as in countries with the Turkish language every ice-mountain is a Mus-tagh. As to the Tibetan name of the lake I heard it pronounced as Mavang or Mavam,

¹ »Three Years in Tibet». Published by the Theosophist Office, Adyar, Madras, 1909.

² Op. cit., p. 38.

³ Compare my »Trans-Himalaya» II and on the map, where it is called Kang-rinpoche.

which also comes nearer to Kawaguchi's Mapham, than any other spelling, provided that his ph is pronounced as f.

However, he continues to a place Pokhra, and over Kaliganga or Kali Gandak to Muktinath and Tsarang, »a town on a stream, and on an elevated part of the town stands a castled palace, in which lives the King of the Lo State, which as he says, was an independent state before the Gurkha tribe had subjugated Nepal. It is obviously the same part south of Kore-la which was called Lo Gyapo or the King of the South to me by the Tibetans of Tradum. He stayed at Tsarang nearly a year. Then he retraced his steps as far as Muktinath, and entered Tibet on July 4th 1900.

He relates that »Jang Thang» literally means »northern plain», but that in Tibet itself this appellation is applied to its western steppes. He passed himself off as a pilgrim from Lhasa, and when asked about the object of his journey he used to answer that he was on a pilgrimage to Kang Rinpoche or Mount Kailasa. It is often difficult to follow his way on the very poor map, which is the roughest sketch imaginable, lacking geographical names, and absolute heights.

Having reached some tents on the northern side of the watershed, he was told he had half a day's distance to a river called Kyang-chu or the Wild horse river, a large tributary of the Brahmaputra, which could not be forded without guides.

On July 14th he continued due north in company with a Ladaki trader. They passed through undulating land where snow remained here and there. They reached Kyang-chu, whence, about fifty miles to the N. W., he saw a great snow-covered mountain. It was in that mountain that the river had its rise, and following its course with my eye, I saw it flow into and disappear in the upper part of another elevation on the south-east. The Kyang-chu was estimated at about 450 yards at places, but in rocky places it dwindled to 60 yards. The depth where they crossed it was 3 or 4 feet, »and another danger was from the blocks of ice floating down from the upper reaches, which we had to take good care to escape, for fear of receiving serious cuts.»

It is difficult to identify this river. It may be the Tsangpo itself, as no southern tributary flows to the S. E. On the other hand his compass-bearings are very unreliable. The dimensions are obviously exaggerated and do not at all agree with the Kubi-tsangpo, which otherwise should be one of the few able to carry ice in the middle of July, although I did not see a single piece of ice in the river, even at the source. But the continuation of the narrative proves that the Kyang-chu can only be a tributary from the S. W.

Then he turned N. W. along the river and after 15 miles he arrived at a nomad station. Now he was in the district of Hor-tosho. Farther on he passed the Kubi-tsangpo and Chema-yundung, a part of his journey that will be treated in connection with the source of the Brahmaputra. From Chema-yundung he proceeded due north, trudging over snow for about 10 miles, reached a grass-covered plain and

a pond. After 11 miles to the N. W. he found a road which led him to a tent, standing on the banks of a large river, named Ganga by the Tibetans. The next morning, August 3rd, he proceeded to the N. W. »This river, I ascertained, had its rise in one of the snowy peaks that I saw to the south-east, and emptied its waters into Lake Manasarovara.» He makes it 250 yards wide and «fairly deep». He followed it nearly 4 miles, made an ascent and came to a clear bubbling spring, called »Chumik Ganga or the source of the Ganga and we drank deep of the sacred water. Climbing farther north he reached a second spring from under an immense slab of white marble. It was called Chumik thong-ga Rangchung or the fountain of joy. »Both these springs are regarded by the Hindus, as by the Tibetans, as forming the sources of the sacred Ganga, and are both looked up to with religious reverence.

Continuing N. W. he once more crossed the river Ganga. From the camp at the banks he saw Kang Rinpoche. »Its ancient name was Kang Tise.» He regards it as belonging to the Himalaya.

All this is of great interest and, in spite of his complete ignorance of the map and of his very untrustworthy bearings and dimensions, which occasionally are exaggerated tenfold, it is not difficult, in this case, to follow his route from his narrative, and the descriptions and names he gives. As no European except myself has been over this ground, nobody would have been able to give due interpretation to his report. The little river he crossed must be the one coming from Tam-lung-la. Thus, we have first Kyang-chu which may be my Gyang-chu; this is even probable regarding dialects and provincialisms in pronunciation. Then he crosses Kubi-tsangpo and Chema-yundung as will be shown afterwards. And finally comes the Ganga, which must be my Tage-tsangpo. For, if he had crossed the united Brahmaputra, as suggested above, he would have had to cross the Chema-yundung twice, and in reality he crossed it only once, unless another little »mountain stream« he mentions should be the upper part of the Chema.

As to the Ganga there cannot be any doubt about its identity with Tage-tsangpo. In its valley I never heard the name Ganga, but when I asked the Lamas of Chiu-gompa about the name of the channel between the lakes, they answered Ngangga or Ganga, and so I have called it on my preliminary map.¹ But as Kawaguchi found the name Ganga on the Tage-tsangpo as well, this points to the fact that the Tibetans regard the Tage-tsangpo as the upper part of the channel, a view which is scientifically correct. The fact that Kawaguchi makes the same mistake as the Lama surveyors and d'Anville in regarding the river as the uppermost part of the Ganges instead of the Satlej does not alter the question in the least. The chief point is that the river Ganga or Tage-tsangpo, together with its two sacred springs, is regarded as the source of a great Indian river. Or, as I formulated my

¹ »Trans-Himalaya», Vol. II.

view in my original report: the Tage-tsangpo is the source of the Satlej. In a problem like this the eastern view may be of extremely great weight. It is built up on tradition and old historical facts and comes down from times in which Europe had no contact with the countries in question and no idea of their geography and hydrography. The religious view of course plays its part, and troubles the sober explanation of the phenomena. Only the Chinese are untroubled by religion. So long as our good Japanese priest sticks to what he has seen with his own eyes, he is all right. But when religion gets hold of him he becomes unreliable. When he tells the world the alarming news that the Ganges rises from the Manasarovar, he is blind, and he never says where the sacred river again goes out of the lake. But in searching the real and original source of the river supposed to go out of the Manasarovar, he points to the Tage-tsangpo, exactly as the Lama surveyors did 200 years ago, and as the Tibetans do, so far as the genetic source of the Satlej is concerned.

He refers to some legends of the Mapham Yum-tso or Anavatapta of Sanscrit and continues:¹ It is said that the lake has four outlets for its waters: Mabcha Khanbab, Langchen² Khanbab, Tamchok Khanbab and Senge Khanbab, which respectively form the sources of the four sacred rivers of India. He says that «it is from these notions that the sacredness of the Anavatapta is evolved, the name of Zenbu derived, and the religious relations between Tibet and India established.»

He does not mention the Ganges, although he had found that its source, the Ganga, falls into the Manasarovar, and he is even aware that there is not one of the four rivers that actually flows directly out of the lake: He understands that they have their sources in the mountains surrounding the lake. Only «the sources of the Tamchok Khanbab have hitherto defied investigation.

He does not believe in the European travellers who have surveyed the lake, as they have represented it far smaller than it actually is. In reality, he says, its circumference is about 200 miles! The shape also, on European maps, is misleading, as it has, in reality, the shape of — a lotus flower. All western maps he finds wrong and incorrect. Here he is a little too rash, for the circumference of the lake is only 45 miles.

The Gurla-mandata he calls Manri. He stayed at a temple called Tse-ko-lo, obviously Tugu-gompa. Next morning he made his way

«to the range of mountains that stands like a great wall to the north-west of the Lake. A zigzag climb of ten miles or so brought me within view of Lake Lakgal-tso, . . . Rakas-tal. It is in shape something like a long calabash, and in area smaller than Manasarovara. Another seven and a half miles brought me to a spot whence I could see the whole of its surface, and here I made a further discovery. A mountain, some two and a half miles round at the base, stands like a wall of partition between the two lakes, and where this mountain slopes into a ravine it looks for all the world, as though there were a channel of communication for

¹ Op. cit. p. 142.

² Here again he gives a more correct spelling than formerly was found on European maps. In the word Khanbab he has mixed Kabab and Kamba.

the water from one lake to the other. I found, however, that there was actually no such channel, but I discovered that the level of Lake Lakgal is higher than that of Manasarovara, and I was subsequently told that, on rare occasions, every ten or fifteen years, after phenomenally heavy rains the waters of the two lakes do actually become connected, and that at such times Lake Lakgal flows into Manasarovara. Hence arises the Tibetan legend that every fifteen years or so Lakgal, the bridegroom, goes to visit Manasarovara, the bride.»

From his description it is impossible to guess from which point and how Kawaguchi made his surprising discoveries. To judge from his map he has not crossed the neck of land between the two lakes. He has got one perfectly true piece of information from the natives, which directly touches the periodicity of the channel between the lakes, namely, that every 10 or 15 years, after heavy rains, the waters of the two lakes actually become connected. But the Tibetans were innocent of his discovery that the Rakas-tal should be higher than the Manasarovar and that the water in the channel flowed from west to east.

His way of thinking does not become clearer after his visit to Mabcha Khanbab, one of the »tributary sources of the Ganga». Thus he attributes both the Tagetsangpo and the Kauriala to the Ganges. He adds that modern Hindus regard the »Haldahal» branch as the main stream but that in ancient times the Mapchu was considered to be the principal source. Therefore his views regarding the hydrographical importance and function of Chumik Ganga are very dark, or rather left without any kind of explanation. So long as he contents himself with the simple information he got from the Tibetans he is right, but when he begins to make physico-geographical speculations on his own account he is lost. If he had noticed that the channel, Ganga, between the lakes, is, in its upper part, east of the Manasarovar, called Langchen-kamba as well as, perhaps, Chumik Ganga, he would have remembered that Langchen-kamba is also the name of the great Satlej, and that thus his Chumik Ganga could hardly have anything to do with the river Ganges.

For, after his visit to Gyanima, he came, on August 28th, 1900, upon the »upper course of the Langchen Khanbab», which he rightly recognises as the Satlej:

»My companions volunteered to tell me that this river started from Lake Manasarovara. When I pointed out to them that the Lake Manasarovara was surrounded by mountains on all sides and has no outlet, they replied: 'True, but the river has its source in a spring to be found under a great rock, east of the monastery named Chugo Gonpa (the monastery of the source of the river), in a gorge on the north-western side of Mount Kailasa. That spring is fed by the waters of Lake Manasarovara that travel thither underground. Hence it may be said with equal truth that the river flows out of the lake.' This was indeed an ingenious way of accounting for the popular belief. But judging from the position of the river, it seemed to me that it must take its origin on a higher level than that of Lake Manasarovar and I was not (nor am I now) ready to admit the correctness of the native contention.»¹

Here again Kawaguchi is not successful when he tries to improve the native explanation and he could easily have been ready to accept its correctness. The

¹ Op. cit. p. 159.

natives simply and truly told him the Langchen-kamba came from the Manasarovar or rather that the river had its source in the great rocks east of the monastery of Chugo-gompa. And so it is in reality, for here they must have meant Tugu-gompa as there is no Chugo-gompa on the north-eastern side of Kailas, nor any other *gompa* at all. I never heard the Tibetans ever suggest that the Satlej should come from Kailas and I think the Japanese priest has misunderstood his informants. They are much too simple and natural for such extraordinary fantasies. He goes so far as to tell the Tibetans their lake has no outlet at all. But, as I said before, if his map is correct, he has never even touched the neck of land between the lakes. He only 'discovered that the western lake was higher than the eastern.'

¹ In the popular account of my last journey in Tibet I did not even mention the name of A. H. Savage Landor, for reasons easy to be understood by every serious geographer. I am not going to enter into any details here either, but, for completeness' sake I will touch upon some geographical points of his book.

An article by the same author: »Les sources principales du Brahmapoutre et du Sutledje», in L'Asie Française, December 1910, p. 507 et seq. is addressed directly to me. There the author makes an attempt to prove that he has discovered the sources of the Satlej and the Brahmaputra and established for ever that there is no visible communication between the two lakes. — In L'Asie Française, March 1911, p. 112 etc. M. JACQUES BACOT, a very able and scientifically trained explorer of Eastern Tibet, has word by word criticised and annihilated the above article, in an article under the title; »Quelques réflexions sur des voyages au Tibet», which I recommend to everybody interested in the question.

In the Preface to his book (In the Forbidden Land, London 1898), Landor says: »The map is made entirely from my surveys of an area of twelve thousand five hundred square miles in Tibet proper.» To which Sir THOMAS HOLDICH adds the modification: »The maps which he has brought back do not differ materially in topographical detail from those with which he was supplied on his outward journey, and the record of observations consists mainly of a traverse which, when projected, can only be reconciled to the maps with difficulty.» Geographical Journal, Vol. XII, Dec. 1898, p. 588. In Nature, November 3, 1898, Sir Thomas Holdich says of his map that it »differs in no essential particular from that of the Indian Survey, except that he shows an error in longitude». In Geographisches Jahrbuch, XXII, 1899, p. 359, Dr. E. TIJESSEN says: »Die Reise . . . hat so gut wie keine geographische Ergebnisse gehabt», and refers to criticisms in Verhandlungen der Gesellschaft für Erdkunde zu Berlin, XXVI, p. 113; Ost. Monatsschrift für d. Orient, XXIV, 12, p. 135; Petermann's Mitteil. 43, p. 295; A travers le Mond, III, p. 364; and Globus, LXXIV, p. 323.

It is impossible to follow him day by day from camp to camp, for so far as Tibet is concerned there is not one date related in the book and the records of temperature he gives are therefore without interest and value. In the preface he calls his book »the record of a journey in Tibet undertaken during the spring, summer and autumn of 1897», which should give at least 200 days for the journey in Tibet. Thanks to a certain Mr. Larkin we know that he entered Tibet on July 13 by the Lumpia pass, and thanks to another gentleman on the frontier, Mr. Wilson, we are told that he returned to Taklakot on September 8. This makes 58 days in all for Tibet. From Mr. Wilson it is also clear that the return journey from Tuksum to Taklakot took him 15 days. Thus his way out, to a place called Namj Laccé took him 43 days. This last camp to the east has N:o 57, so his camp N:o 1 must necessarily be situated at Bombay or somewhere else in British India. On the map the precaution is taken only to enter the numbers of camps 51, 54 and 57. Otherwise, as he has been only 58 days in Tibet, and has 57 camps to the east only, he must have done the return journey in one day. It may be that he sometimes has two camps in one day. This seems the more likely, for Mr. Larkin again kindly comes to our assistance (Vol. II, p. 217): »On the 19th of August 1897 they went to a place called Toxem». As they entered Tibet on July 13th the same year the journey to Toxem cannot have taken more than 37 days. As calculated above it took 43 days to camp N:o 57, which was 21 miles farther east. But the six days between the two last camps were spent with »torture». In the text the camp numbers are missing altogether. Reckoning in the book, from the Lumpia pass to

Kawaguchi followed the way from Gyanima and proceeded westwards along the Langchen Khanbab and came upon a river flowing down from the north to the

Camp 57 and back to Taklakot, one arrives at 62 days in all, instead of 58. But as the dates of the two above-mentioned gentlemen are in semi-official reports, they must be trusted.

It is indeed difficult to reconcile this traveller's traverse with existing reliable maps. Toxem (Tuksum) he places at $84^{\circ} 48' E.$ long., although it is in reality (Ryder) at $83^{\circ} 30'$, and already on Nain Sing's map of 1866 at $83^{\circ} 25' E.$ long. The distance between Tuksum and Taklakot, as the crow flies, is on his map 224 miles, in reality only 144 miles. Along the road it is 290 miles in the first case and only 200 in the second. For the journey from Tuksum to Taklakot 15 days' marches were required. During the first 5 days, out of these 15, he covered 178 miles, but afterwards not quite such great distances. There really remained only 22 miles for the last 10 days! So he covered 178 miles in 5 days, and 22 miles in the next 10 days. Take another example, it does not matter where, the result will always be the same. For the distance, say between Maryum-la and Tuksum, Nain Sing found 71 miles, and Ryder, the most exact surveyor who ever was in Tibet, 72 miles. Mr. Landor has found it to be 141 miles or exactly the double! So Nain Sing's conscientious survey cannot be said to have been improved by this traveller, who says of Nain Sing's map: «La carte qui a été publiée aux Indes d'après ses renseignements est de plus rudimentaire, et telle qu'un enfant européen de dix ans pourrait faire bien mieux.» (*L'Asie Française*, December 1910, p. 511). And still, in the very few cases where his map is correct, as for instance in the lower part of Samo-tsangpo, it has been taken from Nain Sing. Even the three northern tributaries are entered as Nain Sing saw them. The upper part of the same river has not been improved, for it has been dragged out to the double of its real length.

I will remain objective in this extraordinary case of «exploration», by giving only quotations. Thus we find the following statement about the channel between the lakes, much more striking than even Kawaguchi's «discoveries»: «It was my good fortune to make quite sure from many points that, as can be seen from the illustration reproduced in these pages, the ridge between the Rakas and Mansarovar Lakes is continuous, and no communication between the two lakes exists. With the exception of a small depression about half-way across, the ridge has an average height of 1,000 feet all along, a fact which ought in itself to dispose of the theory that the two lakes are one. I also further ascertained from the natives that there is no communication whatever between them, though the depression in the ridge makes it probable that at a very remote period some connection existed. The lowest point in this depression is over 300 feet above the level of the lake.» Op. cit. I, p. 257. To which Holdich gives the following comments: «he has fallen into the inexcusable error of making a positive assertion about the physical conformation of the lake surroundings without having actually traversed the ground to which he refers. He states that there is no connection between the Manasarowar and Rakas-tal, but he failed to push his exploration right across the intervening ridge so as to ascertain positively whether there was, or was not, such a connection.» Geogr. Journal, Vol. XII, Dec. 1898, p. 588. — In an article: «Connection between Mānasarovar and Rākas-tāl» (*Nature*, November 24, 1898, p. 76) Sir Richard Strachey says of his brother Henry: «He did not visit the actual point at which this stream leaves Mānasarovar, but in 1849 I did so, and there is no more doubt about the fact than that the Thames runs past Richmond.» But our traveller replies: «Such other trifles as the connecting of lakes by imaginary rivers to maintain the reputation of a scientific impostor (Henry Strachey!), or the building of accurate maps from badly taken photographs are frauds too commonly perpetrated on the innocent public by certain so-called scientific societies (The Royal Geographical Society!), to be here referred to.» Across Coveted Lands, London 1902, Vol. I, p. 332.

In a Correspondence to the R. G. S. a certain Mr. G. Kendall-Channer writes about our explorer that he «was very anxious that I should write to you to state that in August, 1895, when up travelling in Tibet . . . I practically crossed the ridge dividing the Mansarovar and Rakastal lakes. I . . . kept along the crest as much as possible. I saw no 'ditch' connecting the two sheets of water. The connection I believe to be a tunnel. The pundits with whom I have talked over the matter deny any cutting between the lakes.» (*Geographical Journal*, Vol. XV, p. 75). The supposed discovery of the tunnel is a very good joke. I wonder whether any other lake on the earth has had so much to support and to suffer as the sacred Manasarovar?

From Tugu-gompa he continues to the E.N.E., crossing a river, on which »Tokchim« is situated, and reaching another where the »Tajrum's encampment« is found. In reality Tokchen is the Tarjum's

Langchen Khanbab. There were two others running parallel and at a short distance from one another. They are called Tokpo Rabsum. After $1\frac{1}{4}$ mile he came to

encampment. Twenty eight out of his 30 servants had bolted when he followed the second river (Samo-tsangpo) on its right bank (the left on his map). «A chain of snowy peaks stretching from south-west to north-east» was seen. It is not said whether this chain was north or south of the route, but it does not matter much, as there is no such chain in this part of Tibet. His further route does not agree with any existing map, but as he travelled between Tokchen and Maryum-la, as Nain Sing had done in the opposite direction, he obviously followed the *tasam*. On his way to Tokchen he must have crossed the lower course of the Tage-tsangpo, but there is no sign of it, either in the text. or on the map, although, 13 years later in Paris, he pretends to have discovered both the eastern source of the Satlej (Tage-tsangpo), where he had never been, and the western, Darma-yankti, which was discovered by Henry Strachey in 1846. (Journal Asiat. Society of Bengal, as above).

However, he crosses Maryum-la. A little rivulet, hardly six inches wide, descended amongst stones . . . This was one source of the great Brahmaputra, one of the largest rivers of the world. I must confess that I felt somewhat proud to be the first European who had ever reached these sources . . . (Op. cit. Vol. II, p. 40). Desideri and Freyre were the first Europeans to cross the Maryum-la and to see the sources of the Maryum-chu, which is a tributary to the uppermost part of the Tsangpo.

What he says of the «Gangri Chain» stretching eastwards from the Maryum-la, and of which only the southern ranges can be seen from his route, is correct, and had already been said and proved by Nain Sing. To the S.E. and S.W. he could see «a very high, snowy mountain range», of which, however, there is no suspicion on his map. Nain Sing had it on his map 30 years earlier and gives the correct legend: «Many large glaciers». Webber and his party had crossed it somewhere.

On leaving Tarbar (not on his map, nor on any other map) he admired the »magnificent panorama of the great rugged mountain-range to the S.W.« The higher peaks were nearly all of a pyramidal shape, and at $226^{\circ} 30'$ (b. m.). »I observed a gigantic quadrangular peak, which I took to be Mount Everest.« Op. cit. Vol. II, p. 84. Which is situated some 300 miles or $3\frac{1}{2}$ east of the point where he must have been when he believed he saw it to the S.W.!

The critical encampment was called Toxem or Taddju, from where he was brought to »Namj Laccé Galshio or Gyatsho«. There was on a hill a fortress and a large lamasery, which had, however, disappeared when Ryder and I travelled that way, unless the poor little Ganjo-gompa should be meant, which is, however, situated at $83^{\circ} 37'$ E. long., whereas Namj Laccé is at $85^{\circ} 8'$ E long. We have already seen that he has placed Toxem (Tuksum) at $84^{\circ} 48'$ E. long., instead of $83^{\circ} 30'$, by which manipulation, so easy to control, he gained some 93 miles towards the east.

From »Namj Laccé« he is brought back to the west. :On reaching a spot which from observations taken on my outward journey I reckoned to be in longitude $83^{\circ} 6' 30''$ E. and latitude $30^{\circ} 27' 30''$ N. I had a great piece of luck. It is at this point that the two principal sources of the Brahmaputra meet and form one river, the one coming from the N.W., which I had already followed, the other proceeding from the W.N.W. The Tibetans, to my delight, selected the southern route, thus giving me the opportunity of visiting the second of the two principal sources of the great river. This second stream rises in a flat plain, having its first birth in a lakelet in approximate longitude $82^{\circ} 47'$ E. and latitude $30^{\circ} 33'$ N. I gave the Northern source my own name . . .« (Op. cit. Vol. II, p. 178). I do not need to discuss this passage, as it is sufficient to refer to the chapter dealing with the source of the Brahmaputra, which is *one* and situated $82^{\circ} 16'$ E. long. and $30^{\circ} 7' 30''$ N. lat. There is not even a small tributary which rises in a lakelet on a flat plain, as even the lakelets must be fed from somewhere. And as to the »Northern source«, to which he modestly gave his own name, it should be baptised after its first surveyor, Nain Sing, who was a reliable and trustworthy man, — if it had not already a Tibetan name: Maryum-chu.

His Tibetan geography has been characterised by Jacques Bacot in the following words: »Il est déjà extraordinaire que M. Landor ne veuille pas reconnaître son erreur passée. Mais qu'il s'obstine à faire confirmer et endosser cette erreur par tous les voyageurs qui l'ont démentie, c'est là un cas spécial qui sort du domaine géographique . . . Je ne sais quelle préoccupation le pousse à ces dénégations répétées de l'évidence; elle ne peut être qu'étrangère, à moins que hostile à la géographie.« (L'Asie Française, Mars 1911, p. 113, 119). Jacques Bacot who knows the Tibetans from his own experience (Vide: Dans les marches Tibétaines, Paris 1909; Le Tibet Révolté, Paris 1912, etc. etc.), in regarding the tortures as the single certain result of this journey, adds: »Il a trouvé des Tibétains lâches et cruels alors que les voyageurs qui l'ont précédé et suivi au Tibet ont vu des Tibétains doux, gais et hospitaliers. Outre

another stream of the same name. Here he is right and he clearly points out that these rivers are tributaries of the Langchen-Kamba.

Then he came to a town» called Reta-puri (Tirtapuri), where he visited the divine Grotto and the hot springs. He returned north of the two lakes and made the pilgrims' way round Kailas. The names he gives of the four temples do not agree with the ordinary ones. But for the pass, Dolma-la, he has the right name, and so is the case with Darchen Tazam.

His further way goes over »Tokchen Tazam to Kong-gyu-i Tso: (Gunchu-tso). He did not take the road over Maryum-la but went in a more southern direction as will be seen later on.

qu'elles font honneur à sa résistance physique, les tortures de M. L. ne sont pas stériles. Elles donnent un grand enseignement: ces peuples qu'on dit immobiles sont sujets aux changements, à des sautes de caractère subites et inexplicables. Mais pour donner géographiquement raison à M. Landor . . . , il faudrait admettre que les pays, les montagnes et les fleuves sont sujets aux mêmes caprices que les peuples. Je n'ai pas cru pouvoir aller jusque-là.»

No less than 42 pages in his book are filled with certificates which probably are meant to prove that there is no humbug in the story. Mr. J. Larkin specially has been busy. He tells us (p. 223) that the Tibetans who took part in the tortures did not try to hide it. And »there can be no doubt that the above account is true and unexaggerated, for the whole of Byans and Chaudans are singing with it.» Ten years later, when I passed Tuksun (Toxem) and other places on the road to the west I could not find *one* Tibetan who remembered that any foreign traveller had been tortured in their country. Which by no means argues against the veracity of the victim! It only gives us an opportunity for another interesting discovery: the Tibetans are very short of memory. — Further the Pioneer Mail of October 14, 1898, has the following with reference to the certificates in the Forbidden Land: »We have the best authority for stating, as we did the other day, that Mr. Landor was told that his report was confidential, that no copy was given him, and that he was not authorised to publish any Government report. The certified copies of depositions made in Mr. Larkin's Court should not be mistaken for M. Larkin's report.»

All the names on the western part of the map accompanying »In the Forbidden Land» were known before, except »Devil's camp, and »Terror camp». A circumstance that makes the book comfortable to read and the itinerary easy to study is the complete absence of geographical names east of Maryum-la. Except Toxem and Namj Laccé there is not *one* name. Nain Sing has nine.

The weather report he gives from the summer of 1897 is extremely interesting. »Downpours, torrents and bucketfuls» of rain, hail and snow almost every day. Only approaching Tuksun, where other hardships were in store, did the weather improve. Such abundant precipitation is quite exceptional in the part of Tibet where our lakes are situated. But it really happens from time to time, periodically, and in such years the channel between Manasarovar and Rakas-tal is filled with streaming water, although the surface of Manasarovar does not need to rise 300 feet, which he says was the lowest point in the neck of land between the two lakes. And it may even happen that a river goes out of the Rakas-tal, which, judging from his map, seems to have been the case in 1897! As a curiosity it should be noticed that in his book of two volumes the name of Satlej is not even mentioned, though the author, 13 years afterwards, tries to make the members of L'Asie Française believe that he has discovered *two* sources of this river.

But »such trifles» as some 90 miles more or less or the probable appearance of Mount Everest in Western Tibet, do not seem to matter very much to »the innocent public» for whom the book is meant. For the really innocent public would probably not have minded if he had said Chimborazo instead of Mount Everest. But in »so-called scientific societies» this sort of geography is not accepted. We listen with delight to the old missionaries who expect that their simple tales shall be believed — without certificates. And with intense interest we try to make the best of the accounts of the fakirs and other natives, for they give their misunderstandings *nolens volens* and *bona fide*, and they are honest.

CHAPTER XVIII.

THE LAKES AND SOURCES DESCRIBED BY MODERN COMPILATORS.

To give an idea of the European knowledge of the geography of our lakes and the sources of the great rivers in the years preceding the latest visits, I have in this chapter brought together the views of some competent geographers, who have published books on Tibet generally, or otherwise paid attention to its geography.

On his journey in the upper valleys of the Himalaya ANDREW WILSON also proceeded to Shipki, above which place he suspected the plains of the upper Sutlej should be situated in »Chinese Tibet». He thinks that some of the peaks of the Kailas may be higher than Gaurisankar and that it well deserves to be called the centre of the world. This cluster of mountains he regards, at any rate, as "the greatest centre of elevation, and the point from whence flow the Sutlej, the Indus, and the Brahmaputra." Regarding the upper Indus he says it is unknown above Ladak: »As the Sutlej is supposed to proceed from the mouth of a crocodile (at another place he correctly says elephant), so the Indus comes from that of a lion.» On his map: »A map to illustrate the Abode of Snow by A. Wilson Esq^{re} 1875», the Sutlej does not come from the »Tibetan Kailas» at all, but from the country east of Manasarovar and flows through both lakes.¹

A nameless author in the Calcutta Review says of the source of the Satlej: »The head waters of the Sutlej pass from their springs on the north-east of Rakas Tal through that lake, but the stream is soon turned from its lateral course by the southern extremity of the snow-clad spur which runs from Hanle to a point south of Gartok.²

LÉON FEER in his excellent little book³ on Tibet categorically declares: *'Au pied du Kailâsa, deux lacs voisins communiquant entre eux, dont l'un, le plus oriental,*

¹ The Abode of Snow. Observations on a Journey from Chinese Tibet to the Indian Caucasus, through the upper valleys of the Himalaya, by Andrew Wilson. Edinburgh and London, 1876, p. 117.
¹⁷³ and 407.

² Trans-Himalayan missions and their Results. The Calcutta Review, Vol. LXIV, 1877, p. 150.

³ Le Tibet, le pays, le peuple, la religion. Paris 1886, p. 11.

le Manasarovar, est célèbre dans les traditions indiennes, l'autre est celui dont sort le Satledge . . .»

DAVID ROSS places the sources of the three rivers as follows: «The river Sutlej has its source in the holy lake of Manas Sarovara in Chinese territory, at the base of the Kailas mountains, 22,000 feet high. The source of the Indus is at the foot of the sacred Kailas mountain, an unexplored region in Great Tibet, 22,000 feet above the level of the sea, considered by the Hindus to be the seat of Siva's paradise and the mansion of the gods. On the southern slope of the same mountain the Sutlej has its source. . . The Indus and the Brahmaputra rivers rise close beside each other, but they flow in exactly opposite directions.¹

Colonel H. C. B. TANNER in his article on the physical geography of the Himalayas takes a more skeptical view:² »I here remark that the moot question as to whether the Satlaj actually issues from the Mansorawar lake or not, does not appear to have been definitely settled, though controversies have been raised on the point, and notwithstanding that more than one Englishman has actually been along the supposed bed as far as the lake.» It is characteristic for the whole situation of the problem, that such an opinion could be expressed by an expert on Himalayan geography so late as only 25 years ago. And here again it is the periodical function of the channel which is responsible for the doubt.

A quotation from the always clear and concise geography of ELISÉE RECLUS should not be omitted in this connection. He has the following passages of the sources of the Sutlej and Indus:³

»La moitié la moins déclive de la fosse méridionale du Tibet est celle dans laquelle s'épanchent les eaux du Satledj. Un lac, le tso Kongkio, en occupe la première terrasse, dans le voisinage du seuil: c'est une nappe d'eau sans écoulement, devenue saline comme presque tous les lacs fermés. Quelques autres étangs d'eau salée sont parsemés dans les alentours, mais les deux grands bassins de la vallée, le Mansaraour et le Rakus-tal, sont des lacs d'eau douce, unis par un ruisseau permanent, apportant au Satledj un flot divin, car le Mansaraour, le Manasa Sarovara des légendes hindoues, est le 'lac formé du souffle de Brahma . . .' En sortant du Rakus-tal, qui est le Lanagou Lanka des Tibétains, le Satledj, Satradu ou Satadrou, se dessèche parfois à la fin de l'été: le fleuve n'a de cours permanent que plus bas dans la vallée, où il commence à se frayer un chemin à travers les débris . . . Plusieurs des rivières qui naissent au nord du Gang-dis-ri étaient désignées jadis par les indigènes comme étant la source maîtresse du Scind ou Indus, et on leur appliquait également le nom mythique de Senge khabab, 'Fleuve sorti de la Gueule du Lion'. On les appelait aussi Singi tchou ou le 'Courant du Lion', nom qui se retrouve dans l'ancienne dénomination sanscrite de Sinha, légèrement modifiée de nos jours. Les explorations faites par les géomètres anglo-hindous ont établi que le véritable Indus est, parmi ces rivières, celle qui naît le plus à l'est, non loin du versant septentrional du Mariam la.»

¹ The Land of the Five Rivers and Sindh, London 1883, p. 37 and 221.

² »Our present Knowledge of the Himalayas.» Proceedings Roy. Geogr. Society, Vol. XIII, 1891, p. 403 et seq.

³ Nouvelle Géographie Universelle, VII, L'Asie Orientale, Paris 1882, p. 39 et seq.

The text, so far as the source of the Indus is concerned, does not agree with Reclus' little map, taken from Walker. For there the Kailas is situated on the water-parting range north of the lakes, and the Indus takes its rise from the northern and N.E. slopes of the Kailas, far west of Maryum-la, and separated from it by another hydrographic system.¹

Speaking of the Lopchak Mission from Ladak to Lhasa R. L. KENNION, mentions the sources of the Indus and the Brahmaputra. He says that »their (the merchants') road lies along the banks of the Indus, but lately sprung from his cradle among the peaks of Kailas.» And further: Passing on from here (Gartok), they will continue their journey towards the rising sun, through the land of Boongpa, 'where there is gold', leaving the sacred mountains of Kailas, the mystic sources of Indus and Brahmaputra and the famous lakes of Mansarowar, on their right hand, and so on to the great monastery of the yellow lamas at Tashi Lunpo.² It is not surprising that he places the sources of the Indus among the peaks of Kailas, but how the Kailas with the sources of the Indus can be situated to the right of the road to Tashi-lunpo, is hard to see.

This is what the Rev. GRAHAM SANDBERG, B. A. said of the sources of the three rivers, in 1904:³

»The sources of the Yeru Tsangpo have not been visited as yet, though they have been pretty accurately located; but then the sources of the shortest great river rising in and flowing out of Tibet, the Sutlej, are not to this day absolutely known. Furthermore, it is still a subject of mystery and speculation where so familiar a river as the Indus actually takes rise. The origin of one branch is comparatively plain — it lies to the N.W. of Kailas and flows past Gartok. However, the sources of the eastern branch of the Indus remain unvisited. We have not yet seen a good diagnosis of their approximate situation in any authoritative article. Nevertheless, examining a certain old report or diary of a native explorer, we noted that he approached these eastern sources, though he did not positively reach them; but he gives the important information that they lie not far from Mariam La, in streams varying in situation and from 10 to 20 miles N.E. of that Pass. in a range styled Gangri Gurgyab.»⁴

Sandberg was a good scholar in matters Tibetan, and, so late as in 1904, he knew very little of the origin of the three rivers. Of course the whereabouts of the sources were known, but the situation of the very sources had not been settled, for nobody had visited them. Only for the source of the Indus had he searched in vain for even an approximate situation. The native explorer, who located the source of the Indus to the mountains N.E. of Maryum-la, was one of the Pundits.

¹ Vivien de Saint-Martin expresses the following opinion of the source of the Satlej: «Sa source probable est dans la chaîne du Kailas ou Mérou, sur le versant septentrionale duquel naît l'Indus, tandis que le Yarou-Dzang-bo ou Brahmapoutra a son origine à l'Est même du Satledj. et le Maptchou... au S. O. Cette source est à 55 km. ESE. du Kailas... Nouveau Dictionnaire de Géographie Universelle, Paris 1879.

² Blackwood's Magazine Vol. 174, 1903, p. 379.

³ The Exploration of Tibet. Its History and Particulars from 1623 to 1904. Calcutta, London, 1904.

⁴ Op. cit. p. 4.

Speaking of Henry Strachey,¹ Sandberg finds it likely that the filtration from the N.W. corner of »Tsho Lagran» may form the beginnings of the Satlej, »whilst at extreme floods the lake itself probably overflows the margin at this point». But most of the water comes from the valleys west of Kailas and through the Darma Yangti, the same river which Moorcroft called Chhu-garh. And, relating Strachey's description of the channel between the lakes, Sandberg correctly adds:²

»Such averments from an observer so reliable as Henry Strachey seem conclusive as to the existence of a connecting stream between the two lakes. Other travellers cast doubt upon this point, but with the exception of one native explorer of the Indian Survey Office none have passed actually over the ground as did Strachey . . . The survey he made of the sacred lakes and of the country intervening between them and the two passes in Garhwal still forms the foundation of our latest maps of this territory. Mr. T. Kinney and the late Mr. Ryall in 1876—77 made considerable additions on a survey expedition in these parts, but those gentlemen did not succeed in penetrating even half-way to the lakes.»

On the rough sketch-map accompanying his book Sandberg has placed the source of the Indus due east of the Gang Tise or Kailas. His views of the source of the Brahmaputra are obviously taken from Nain Sing. He has no connection between the two lakes, which does not agree with the text, but he makes the Satlej begin from the western one, which he correctly calls Langak Tsho, in the text even Lang-gak which is still better and the only pronunciation I heard round the lake. The sacred lake he calls Mapang Tsho.

In his book on Tibet³ Sir THOMAS H. HOLDICH refers, in the same year as Sandberg, to the knowledge of Tibetan geography. »The Indus rises on the slopes of Kailas, the sacred mountain, the Elysium or Siva's Paradise of ancient Sanskrit literature.» This is the same view as was expressed by Desideri, who says that the source of the Indus is situated on the western side of the Kailas. So the question about the place of the source of the Indus had not been very much improved from 1715 to 1904, — in spite of the survey of the Pundits. Regarding the source of the Satlej he is not quite clear, for he says (p. 13): »The Sutlej rises on the southern slopes of Kailas. It flows no longer from one of the sacred lakes of Manasarawar, famous in Hindu mythology. Abandoning its ancient cradle in Rakhas-Tal, it now issues from the foothills of Kailas.» Speaking of the road from Narkanda to the frontier, he says (p. 20): »Once in Tibetan territory this route follows the southeasterly course of the Sutlej to its source near the Rakhas-Tal, the westernmost of the twin lakes of Manasarawar.» Farther on (p. 39) when the sources of the Brahmaputra are regarded as situated on the Maryum-la, he regards this pass with surrounding mountains as »the meridional water parting between the Indus and the Brahmaputra». And finally, speaking of exploration survey of natives, notably that of Nain Sing, he says

¹ Op. cit. p. 132.

² Op. cit. p. 134.

³ Tibet, the Mysterious. London 1904, p. 12 et seq.

(p. 228): »One of the earliest was also one of the best, for it opened up to us a new era in Trans-Himalayan knowledge. It revealed for the first time something of the nature of that central watershed which separates the rivers of the north, the upper Indus, and the upper Brahmaputra, from each other, or rather from the intervening lake land which gives birth to the Sutlej.»

Thus in one case the source of the Sutlej is situated on the southern slopes of the Kailas, in another near the Rakas-tal, and in a third in the lake land between the upper Indus and upper Brahmaputra. All this may, of course, be said to be correct, except the first mentioned case, for even if the whole of Kailas belongs to the Sutlej, the source of the river cannot be placed on the southern slopes of this mountain, from which the Indus also is said to take its rise. If this were true the Kailas would be a very important watershed, which is not the case. The right view is embodied in the third case, where it is said that the intervening lake land gives birth to the Sutlej. In 1904 nothing else *could* be said, as the principal original feeder and the genetic source of the Sutlej were still unknown.

Many travellers and geographers have slightly touched upon the periodicity of the channel,¹ but none has, so far as I know, in a scientific way proved that the periodicity is a phenomenon depending on meteorological factors. Thus Colonel Holdich says:² »Moorcroft failed to note the connection between the two lakes, the existence of which was subsequently established by the two Stracheys.» As shown above the channel was not in function in 1812.³

In his last book published immediately after his death, the Rev. Graham Sandberg gives some new information about the lakes. He had never undertaken any journeys in Tibet himself, but he had been stationed near the Tibetan frontier and had, as he says in his preface, for many years studied matters Tibetan. He directly refers to the periodicity in the following passage:⁴ »The earliest source of the Sutlej is undoubtedly Ts'o Lagran; but the outflow is intermittent, during some periods ceasing altogether, the main feeders of the river being streams from mountains to the north and south of its early course.» It is true that his authority loses some-

¹ In Vivien de Saint-Martin's *Nouveau Dictionnaire de Géographie Universelle*, Paris 1879, it is said, from English sources: »Le Satledj ne sort pour ainsi dire qu'intermittemment du Lanag, car il se dessèche parfois à la fin de l'été, et n'a de cours permanent que plus bas, où il commence à suivre son chemin à travers les débris, dans la plaine de Goughé.» This passage was used by Reclus, as quoted above.

² Op. cit. p. 124.

³ Professor WILHELM SIEVERS' view is more correct: »Der Satledsch entspringt in den heiligen Manasarowar-Seen Tso Maphan und Tso Lanak oder Rakustal, an einer der heiligsten Stellen der indischen Mythologie, in der Nähe des Götterberges Meru in 4660 m Höhe. Diese Seen liegen am Nordrande der Himalayakette zwischen dieser und dem Gangri- und Kailaszuge, . . . Aus dem Tso Maphan fliesst der Satledsch in der Breite von 30 m und mit einer Tiefe von 1 m in rascher Strömung hervor, aber anscheinend nicht immer, und auch sein Ausfluss aus dem Tso Lanak, den der Strom am nördlichen Ende passiert, ist versumpft.» This description is from Henry Strachey, but the periodicity is pointed out. *Asien. Zweite Auflage. Leipzig und Wien, 1904, p. 460.*

⁴ *Tibet and the Tibetans. London 1906, p. 38.*

what when he immediately afterwards adds that the »Di Chhu of East Tibet is also affirmed to start from Chargyut Ts'o in North Central Tibet».

He reminds us of the fact that Nain Sing in his route survey noted a stream from the N. W. horn of the lake, which he designated as the Satlej.¹ And then he has the interesting information, on what authority I do not know, that the natives of the N.W. corner of Langak-tso call the point, where the river used to issue, »the chhu-go» or »river-door», and that the Himalayan traders call it the »nikás» or »outlet of the lake». If this be right it proves that the Rakas-tal is still, at least by some natives, regarded as belonging to the Satlej-system. He enumerates all the feeders of the Manasarovar he knows and concludes that with so large an affluence, it should not be surprising if the lake had an effluence. The fact that the Pundit of 1868—69 agreed rather with Moorcroft than with Strachey, has, in Sandberg's opinion, not much weight, as his attention was not called to the point until he returned, and therefore Sandberg has more confidence in Strachey. And still he has given the only and absolutely correct hydrography in the following words:² On the whole, admitting the definite evidence of the Strachey brothers, it may be said that a small river quits the eastern lake at its N. W. angle, and after a 4 mile's course enters the eastern side of the western lake, but only intermittently.

The ordinary Tibetan names for the lakes he has found to be Ts'o-mo Má-pang and Ts'o Lang-gak, but in literature they are called Ts'o Ma-p'am and Ts'o La-gran, while together they are styled Madrospa or that which does not grow warm.³ The name Lágán is also heard in common talk. The translation of Má-pang is Peacock's breast and of Lang-gak Bull's throat, which also points to the fact that the lake belongs to Lang-chen kamba or Satlej. Sometimes it is said to be called Woma Ts'o or milk lake, which I never heard for this lake, but certainly for others.

The names he has found for the rivers going down from the neighbourhood of Kailas to Rakas-tal, are Khá-lap Chhu and Jom Chhu, whereas Strachey heard the names La Chhu and Barka Chhu. Of the Kailas or Gang Tise,⁴ for which he has not found out the correct name, he rightly says: ·It rears itself up rather to the

¹ Op. cit. p. 52.

² Op. cit. p. 56.

³ Sarat Chandra Das writes Ma-dros-pa or Ma-dros mtsho; and adds that it is also known as Tsho-Ma-pham; ma-dros-gnas means »that lives in water = nāñ-pa swan, goose. Ma-pham he also writes ma-phañ. Tibetan-English Dictionary, Calcutta 1902, p. 947, 948. E. von Zach has Ma-p'am ta-lai, Mapam dalai, »gigantic sea», where dalai is Mongolian. — Lexicographische Beiträge III, Peking 1905, p. 134.

⁴ Sarat Chandra Das (op. cit. p. 515): »Ti-rtse or Ti-se name of a three-peaked mountain (fabulously described in Buddhist works) lying north of the Himalayas near Manasarowar lake. Beyond its northern flanks is the residence of Virudhaka the guardian king of the West . . . In modern days Tise or Kailas is still an object of pilgrimage; and four monasteries stand on its flanks. During the past 100 years only two Europeans have reached the neighbourhood of this famous mountain; Moorcroft in 1812, and Lieut. Strachey in 1846.» The foregoing chapters have shown that this last statement is not correct. — E. von Zach (op. cit. p. 125) has: Gang disri, gangs te-se-ri, snow-mountain.

south of the main Gang-ri range from which it is partially detached.¹ For the »Gur Lha Mandhata» he notes the names Momo-nangli (Strachey), Nimo Namling (Tanner), and Nyima Namgyal (E. J. PEYTON).

The four *kababs* or mouths, sources of the four rivers, Satlej, Tsangpo, Map-chu, and Indus, have often been mentioned above. The Tibetans regard these *kababs* as situated in *gangris* or ice-mountains, or, as E. VON ZACH has it, in glaciers. He explains the names in the following way.² The Langcin² k'abab gangri, glang-c'en k'a-_obabs gangs-ri, is the glacier from which the water flows out as from the mouth of an elephant. Damcok k'abab gangri, rta-mc'og k'a-_obabs gangs-ri, the glacier from which the water flows out as from the mouth of a horse. Mabjiya k'abab gangri, rma-bya k'a-_obabs gangs-ri, the glacier from which the water flows out as from the mouth of a peacock. Sengge kabab gangri, seng-ge k'a-_obabs gangs-ri, the glacier, from which the water flows out as from the mouth of a lion.³

¹ Op. cit. p. 125 et seq.

² The c is to be pronounced as English ch.

³ Sarat Chandra Das is decidedly wrong in explaining the mouths of the four rivers, or *habab-chu-bshi*, to be those of I, Gaṅgā, issuing from the mouth of a bull, II, The Sindhu, springing forth from the mouth of a lion, III, The Tsangpo from the mouth of a horse, and IV, the Satlej »is called *Rma-bya kha habab* because it is supposed to come out of the mouth of a pea-cock.» (Op. cit. p. 917). He has given the Ganga the title of the Elephant river, which belongs only to the Satlej, and to the Satlej he has attached the epithet *ornans* that belongs only to the Karnali or Map-chu.

CHAPTER XIX.

RYDER AND RAWLING.

The struggle of one hundred years for and against the channel between the two lakes had not been sufficient to clear up the problem, and it is not exaggerating to say that none of the Europeans who had visited these lakes had really understood and scientifically analysed their geographical and hydrographical importance. It is with a feeling of relief we read the short description given by Major C. H. D. RYDER.¹ He has not definitely settled the controversy, which was not his object, but his narrative is classic and the picture he gives of the lakes and their relations with the Satilej at the time of his visit, could not have been given in a more distinct, plain and conscientious way.

His journey up, in company with Captain C. G. RAWLING, Captain H. WOOD and Lieutenant F. M. BAILEY, falls in the last months of 1904. So they visited the lakes in the middle of winter, which, for solving hydrographical problems, is the most unfortunate season of the year. So far as I am aware theirs is the only European expedition which has seen the lakes frozen, with only one exception, for father DESIDERI arrived in »Toscioa» on December 1st 1715 and reached the first population beyond Maryum-la on January 4th 1716. As Desideri was on the highest places of his journey on November 9th, he must have visited the lakes at the end of November or at exactly the same time as Ryder and his comrades.

Ryder crossed the Maryum-la on November 26th and continued north of Gunchu-tso (11 miles long, 2 or 3 miles broad), »completely frozen over, and having no outlet at all». Then he crossed »several low passes and generally undulating ground», which seem to have been not water-parting passes between Gunchu-tso and the Manasarovar, but only secondary ones. On November 30th he came in sight of the Manasarovar, to which he gives the Tibetan name Tso Mabang, and which was frozen only 100 yards or so round the edge, in spite of the water being fresh. But, as I found three years later, the depth of the lake is considerable, so it could hardly

¹ »Exploration and survey with the Tibet frontier commission, and from Gyantse to Simla via Gartok.» Geographical Journal Vol. XXVI, October 1905, p. 369 et seq.

be frozen all over so early as the end of November. The Tibetans told me the lake freezes all over, suddenly, in the middle of December, a fortnight later than Langak-tso.¹

Then Ryder says:²

»Skirting the lake we rode across the low hills, which close in on the western side, to look for the outlet . . . We struck the channel a mile below the outlet, a small stream only partly frozen over; this we followed up, and found that it did not flow from the lake, but from a hot spring . . . We then followed up the dry nullah to the lake, and proved that Strachey was, as was to be expected, quite correct. No water was flowing at this time of the year, but the local Tibetans all agreed that for some months in each year there was a flow during the rainy season and the melting of the snows, i.e. about from June to September.³ As a rise of about 2 feet in the level of the lake would cause water to flow down the channel, this appears quite worthy of belief. The length of the channel between the two lakes is about 3 miles. That day, December 2, we reached a Tibetan stagehouse, and next day had a long day's ride to try and discover an outlet for the second lake, the Rakas Tal, or Tibetan Lagang Tso. This lake is very dissimilar to the Manasarowar in shape, and was entirely frozen over. The latter is about the same width, 12 miles north and south, as it is east and west, with an area of 110 square miles; the former is a long narrow lake running north and south, some 16 miles long by 3 or 4 miles wide, with an area of about 55 square miles . . . We found an old stream-bed issuing from the Rakas Tal, but every Tibetan we asked told the same story — that no water ever flowed along it now, but that in days gone by, one man saying before the Sikh war,⁴ water did flow out of the lake and down this channel. We followed it down for some 6 miles along the plain, and could find none of the ordinary signs that water flowed down it until we reached some low hills; here evidently, from the lie of the sand, water flowed at some time of the year, and away from the lake. The lakes being now entirely disconnected at all times of the year from the Sutlej river, the sources of that river must lie in the hills on either side of the valley and west of the lake region.»

Thus Ryder had proved that Henry and Richard Strachey were right after all, and in spite of all that had been written against them. He makes the channel too short, for it is nearly 6 miles long. He found the level of the lake at only 2 feet below the highest point of the channel-bed, which makes it very likely that the lake had overflowed in the preceding autumn. This becomes almost certain as all Tibetans he asked agreed that each year there was a flow during the rainy season. If there had been no flow in the autumn of 1904 they would not have given such a statement.

The Sutlej bed from Rakas-tal he found dry and was told no water had been flowing out of the lake since 1845. Only 6 miles west of the lake he found from the lie of the sand that water at some time of the year flowed westwards. At $8\frac{1}{2}$ miles from the lake, in the same bed, I found, three years later, some small fresh-

¹ Vide: »Trans-Himalaya», Vol. II, p. 180.

² Loc. cit. p. 388.

³ The middle or end of July to September would be more correct, as the S.W. monsoon will hardly get any force in these parts so early as in June.

⁴ The first Sikh war took place in 1845—46, the second in 1848—49. Thus the Sutlej should have flowed out of the lake some time before 1845.

water springs at a lower level than the surface of the lake and probably fed by its water. Ryder, however, regards the lakes as entirely cut off from the Satlej, the sources of which must be sought for north or south of the dry Satlej bed west of the lake region; or else the Manasarovar and Rakas-tal no longer belong to the Satlej system, a view that is, superficially, correct, but genetically and scientifically wrong.

Ryder gives a good photograph of the entrance to the channel from the Manasarovar side.¹ Having fixed the Kailas at 21,800 feet and the Gurla-mandata or Mémo at over 25,000, he went on to Menzé or Misar, which was reached on December 5th. This speed, necessitated by the advanced season and so as not to be shut up in Tibet by snow on the Himalayan passes, was too quick to allow the travellers to make any detailed investigations beyond the survey work. Jerko-la was found to be 16,200 feet high, Gartok 15,100, Ayi-la 18,700 and Totling 12,200. He calls this part the most cut-up country he had ever seen. At Shipki, 9,300 feet, they were able to cross the Satlej on the ice. Shipki-la was 15,400 feet. They reached Simla on January 11th 1905.

Ryder sums up the results of his expedition in the following words:²

»The area we surveyed with the plane-table comes to about 40,000 square miles. We surveyed the Tsangpo from Shigatse to its source, surveyed the Mansarovar lake region, and settled the doubtful points connected with it, which have been the subject of much discussion; we completed the survey of the Sutlej river from its source to where it enters British territory, and surveyed the source of the Gartok branch of the Indus. The triangulation was invaluable for correcting the plane-table work and fixing many heights.»

As will be shown later on, the expedition cannot be said to have surveyed the Tsangpo to its very source, as it went north of the source region and surveyed to the source of the Maryum-chu, which is a tributary. Neither was the hydrographical problem of the lakes definitely solved, which could be done only by wandering round the lakes and measuring all their affluents as well as the depth of the lakes themselves. Only by help of all historical data and detailed exact measurements on physico-geographical objects can a problem of this character be solved. And only in connection with all these data can the question of the situation of the genetic, real source and of the actual, temporary source of the Satlej be answered. For such observations Ryder's and Rawling's expedition had no time and no opportunity. And still their programme was fulfilled in the most brilliant way and from a mathematical point of view their expedition was the most important ever undertaken in Tibet. Ryder's map is classic, and all cartographical work hereafter carried out in southern Tibet will have to refer to it, start from it, and be built up on the strong and solid basis given by Ryder and his comrades.

To Ryder's narrative Captain C. G. RAWLING adds some interesting information, although he only saw the lakes from some distance, but visited the Satlej bed west

¹ Loc. cit. p. 388.

² Loc. cit. p. 390.

of Rakas-tal.¹ He also says of Kailas and the Manasarovar: Both deserve a fuller description than I can possibly give, for we were only able to reach the lake once, and to examine the mountain from the road . . . He correctly says that the Tibetans usually call the lake 'Tso Rimpoché'. Somewhat exaggerated is the statement that 'within a radius of a few miles rise four of the greatest rivers of India — the Indus, the Brahmaputra, the Sutlej, and the Ganges . . .' To the sacred lake he gives 100 square miles and it is nearly square in shape, which indeed may be said to be as true as to say it is round. For it keeps the medium between a square and a circle or ellipse. It is fed by numerous small streams from the Mémo and Kailas, but by no river of importance, although the Tage-tsangpo must be said to be of great importance and much greater than all the other rivers. The fact that the 'extremely salt' lake Gunchu-tso was frozen over from shore to shore to a depth of several inches, whereas the fresh-water lake Manasarovar had only 100 yards of ice round the edge, Rawling correctly explains by one of two alternatives: either the lake (Manasarovar) is of excessive depth, or else it is fed by hot springs. The depth is the principal cause, but there may be comparatively warm springs as well at the bottom of the lake. He regards the channel-problem as solved by the expedition, but has nothing new to say about it, except that the Rakas-tal receives the surplus water of Manasarowar Lake, and is, as far as could be seen, devoid of islands. The first statement was known already by the Lama surveyors, the second is not correct, as there are some 3 islands in the southern part of the lake. On one of them I passed a very uncomfortable night in 1907.

Together with Ryder he visited the bed of the Satlej. Many have supposed that the Sutlej runs from this lake (Rakas-tal), and as Rakas-tal and Manasarowar are connected, it stands to reason that the Sutlej would actually originate in one of the streams that run into Manasarowar Lake. Here Rawling touches upon the correct view, namely, that one of the feeders of Manasarovar must be regarded as the origin of the Satlej, but he did not keep to this view as he and Ryder did not find any signs of an outflow. He was told that there had been one 50 years ago, i. e. about 1854, when 'the overflow took place annually'. Now they found thick incrustations of salt in the bed, which 'would not have been the case had water flowed over it during the last few years. When five miles distant from the shore, we obtained from the sand-marks in the bed of the stream conclusive proof that the Sutlej rises a few miles to the west of the lake . . .' This is not exactly the same view as Ryder expressed, for he considered the source of the river to be situated in the hills north or south of the river bed. Both Rawling and Ryder later on abandoned their original views. Rawling says:² 'Ryder, I consider, is correct in placing the present source in a branch flowing from the southern hills. But four

¹ The Great Plateau, Account of the Gartok Expedition 1904—1905, p. 247 et seq.

² Geographical Journal, Vol. XXXIII, April 1909, p. 424.

months earlier Ryder had written:¹ Following down the bed of the old outlet, Sven Hedin found several springs, which probably are underground channels from the lake. There was no sign of these when Rawling and I were there in December; but as the Rakas Tal was then frozen over, doubtless the springs were also frozen. This, however, proves that the lakes are still connected, though underground, with the Sutlej system.² Henry Strachey observed some filtration of water in 1846, SHERRING, in 1905, heard from the natives that an underground escape was believed to exist. But from his definition of a source Rawling is forced to draw the conclusion that the connection does not exist. The fact that the Rakas-tal is fresh means nothing, he says, as it is 40 or 50 years ago since the lake did regularly overflow and it would take centuries for the Rakas-tal to become salt.³ My own opinion is that the lakes must be reckoned to the Satlej system so long as they remain fresh. Rawling believes the Rakas-tal is steadily diminishing in volume and that it will never again overflow into the channel of the Satlej. I have expressed the same probability for the future development, which seems necessary on account of the constant desiccation going on during post-glacial time. But I have also pointed out the periodical fluctuations of Tibetan rivers and lakes.³

Before I had had occasion to publish anything on the results of my visit to the lakes, Colonel S. G. BURRARD explained the whole problem in a perfectly correct way. None of all the travellers who have seen the region with their own eyes has ever come nearer to the solution, and to the very soul and heart of its hydrography than Burrard, who gives the single right key to the problem in the following words:⁴

»If the water of the Manasarowar lakes overflows *occasionally* into the Sutlej, they must be regarded as belonging to the basin of the latter. We define a basin as the whole tract of country drained by a river and its tributaries: by the word 'drained' we do not imply any perpetual flow, but refer only to times of rain and flood. All the small tributaries of the Himalayan rivers are dry at certain times of the year, but a dry tributary remains a branch of the drainage. If the water from Rakas Tal flows into the Sutlej once a century, and then only for such a short period as to be observed by no one, we shall still be justified in including the lakes in the catchment area of the river.»

The word 'century' is not to be taken in a literary meaning, nor is it of significance that no surface water has flowed out of the Rakas-tal during the last half century. The sole scientific boundary in time for including the lakes in the catchment area of the Satlej can be given by the qualities of the lake-water itself. So

¹ Geographical Journal, Vol. XXXII, December 1908, p. 587.

² Compare Professor Brückner's view, »Trans-Himalaya« II, 188.

³ The level in the two lakes varies from year to year. At the present time they are very low, but there is nothing to prevent them rising gradually in a more or less distant future. Tso-mavang may rise so that its water may again flow through the channel to Langak-tso, and this lake at length may discharge its surplus water, as formerly, through the dry bed of the Satlej. Ibidem p. 187.

⁴ A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet. Calcutta 1907. Part III, p. 163.

long as this water is fresh, whether it will remain so for centuries or thousands of years, and so long as there do not exist any positive proofs that the lakes have been definitely cut off and have entered the same stage of their history as the Pang-gong-tso and Tso-morari, they belong to the Satlej system.

Finally I will only quote Rawling's opinion as to the whereabouts of the source of the Indus. The Pundit was only able to follow up the latter (the main branch) for a few miles, so the actual whereabouts of the source of the Indus is still unknown, though the natives assert that it rises from the northern slopes of Kailas Parbat.¹ So great was still the uncertainty about the situation of the source of the Indus only three years before my visit to the place.

¹ *The Great Plateau*, p. 269.

CHAPTER XX.

THE SOURCE OF THE SATLEJ.

From May to October 1905 Dr. T. G. LONGSTAFF undertook a journey in the Western Himalayas, and six weeks of this time were spent in Tibet, during which he joined company with Mr. CHARLES A. SHERRING, I. C. S. Sherring has published a very interesting account of the journey, from which I will quote some important passages.¹

He calls the Gurla Memo-Nam-Nyimri, the same form that is used by the Great Trigonometrical Survey. Nimo-Numgyl is given by Longstaff as the local Tibetan form. The lakes are called Mobang and Lagang by Sherring and Mo-bang and La-gang by Longstaff. Sherring regards the Indus as rising from the Kailas Range.² The "Sanpoor Brahmaputra" is said to rise from the Mariam or Maryum Pass. On the map the legend: "Source of the Brahmaputra River" is found in $82^{\circ} 25'$ E. long. and $30^{\circ} 33'$ N. lat., a few miles south of the Maryum Pass. The Gurla Pass, between Karnali and the lakes, is given at 16,200 feet. Of Moorcroft he says that he saw the source of the Sutlej river. The circumference of Manasarovar is correctly given at 45 miles. He knows four of the monasteries round the lake: Gozul, Thokar, Jaikep and Jiu.

Already in the preface he calls attention to a very good panoramic view of the whole length of the channel with one lake at each end. "Every reader can now solve for himself those problems which have engaged the attention of the public for a century, viz., as to whether there is any, and if so what, connection between the two lakes." Quoting Strachey he adds:³

"This statement is undoubtedly quite accurate, for we saw the channel which answered the above description. It is a fact that at this present moment no water is actually flowing between the two lakes, the reason being that storms blowing from the east have thrown up sand at the mouth of the passage to a height of about 4 feet, but the best native information on the spot gives it as a fact that after heavy rains the water traverses the channel. The last

¹ Western Tibet and the British Borderland, etc. London 1906.

² Op. cit. p. 45.

³ Op. cit. p. 272.



THE VALLEY OF THE UPPER SATLEJ, BELOW TIRTAPOURI.



occasion was eleven years ago, when exceptional rain fell and there were floods accompanied by great loss of life to cattle . . . At present the bed is full of stagnant water (saline) and there are many hot sulphur springs . . .

He reminds us of the fact that the only boat that so far had been launched upon the Manasarovar was that of Mr. DRUMMOND, Commissioner of Bareilly.¹

Sherring expresses the following somewhat audacious theory: the whole of this land as far as the foot of the Kangri or Kailas range of mountains must at one time have been a lake and part of the Rakas Tal, for the ground is very little higher than the level of the lake, and in times of much rain becomes absolutely waterlogged and very difficult to traverse . . . For the foot of the Kailas range, for instance at Tarchen, is at 4698 metres, which would not agree with the outflow of the Satlej, where the vertex of the bed is nowadays 4 or 5 metres above the Rakas-tal (4589). Even admitting the progress of erosion the eventual beachlines should not resist destruction for such a long time as were needed for the erosion cutting down the bed of the Satlej to 104 metres.

It is difficult to recognise the monasteries from the names he gives. Gangta monastery is said to be most interesting on account of a library of books, but it is not said where it is situated.

The most important passage in the book is the following:² The actual source of the Sutlej is at the monastery of Dalju, where there is a large spring, though a dry channel is continued up to the Rakas Tal, and in places in this channel water is found . . . The local statements all agree in asserting that there is an underground flow of water throughout the entire length of this dry channel, which occasionally comes to the surface only to disappear later on. There can be no doubt that during a season of very heavy rain and floods this dry channel would connect the source at Dalju with the Rakas Tal: I came to the same result regarding the underground filtration, and a strong precipitation would no doubt cause an outflow.

He regards Misser (14,300 feet) or Misar as situated on one of the tributary sources of the river Sutlej. Of the Jerko-la he says: Soon after crossing this pass one of the sources of the Indus, the Langboche, or Elephant's trunk, is met with. I have never heard this name for the Gartang-chu, and it cannot possibly be a revival of the Latchou on d'Anville's map. Satlej is, as we know, the Elephant river.

Interesting it is to hear that during 1905 'the rainfall in Western Tibet was smaller than it had been for many previous years'.³ Of 1906 I have no record. But 1907 was an exceptionally dry year, and in 1908 a considerable amount of rain fell both during the later half of July and the whole of August. From 1905 to

¹ »The incident is quite fresh in the minds of the people although it took place in 1855, and the course followed by the little craft was pointed out to us as remembered by tradition. It has been said that the Tibetan official in charge of this part of the country was decapitated by order of the Lhasan Government for permitting such terrible sacrilege . . .»

² Op. cit. p. 284.

³ Op. cit. p. 328.

1907 there was a depression in the curve of precipitation, between two maxima. But already in 1908 the curve had begun to rise decidedly again as will be seen in the next chapter.

On his map there is no connection between the two lakes, but the Satlej issues from the Rakas-tal.

Dr. Longstaff joined Sherring on June 27th and entered Tibet on July 14th by the Lipu Lekh pass (16,780 feet). He was the third European to visit Taklakot. After a trip to Gurla he rejoined Sherring on July 29th and marched the next day along the neck of land which separates this lake (Manasarovar) from that of Rakas, and camped on the shingle beach below Jiu Gom-pa, having crossed the partially dry, but deeply cut, connecting channel at the hot springs. The east end of the channel was closed by a raised bank of shingle, apparently due to wave-action, although there are signs, especially on the low cliffs at the north-west corner, that the level of the lake has fallen in recent times.¹ Referring to p. 34 above, I will only say that this description of the very mouth of the channel does not quite agree with the one given by Sherring who saw a 4 feet high wall of sand thrown up by the eastern storms, whereas his companion saw a raised bank of shingle due to wave action. In 1907 and 1908 there were none, but this may be different in different years.

Then they continued to Misser (Misar), Tirtapuri and Gyanima. The Gyanima lake was smaller than in Strachey's time, which is not surprising as in Strachey's days the Manasarovar had a strong outflow, whereas the summer of 1905 was unusually dry as Sherring tells us.

On their way to the Shelshel pass (16,300 feet) they forded the Darma Yankti, Gan Yankti and Chu Naku, all rapid glacier streams with only slightly sunken beds. The former is undoubtedly, as Sir Henry Strachey suggested in 1846, the longest branch of the headwaters of the Satlej, while the three streams which combine to form the Chu-Kar must carry a greater volume of water than the Satlej where I forded it at Tirthapuri.²

As I only saw the mouth of Chu-kar from the northern bank of the Tirtapuri Satlej I cannot judge, but find it not unlikely that the Chu-kar carries more water, generally, than the Satlej, although I found the northern, Transhimalayan tributaries to the Satlej very considerable in 1908. But adhering to Colonel Burrrard's definition, the Darma-yankti is not the longest branch of the headwaters of the Satlej, for from its source to the junction it is, as the crow flies, only 43 miles long, whereas the length, from the source of the Tage-tsangpo to the junction, as the crow flies, and including the lakes, is 93 miles.

¹ "Notes on a journey through the Western Himalaya." Geographical Journal, Vol. XXIX, Febr. 1907, p. 201 et seq.

² Loc. cit. p. 208.

At a later occasion¹ Dr. Longstaff has made a very able and interesting historical analysis of the changes he supposes have taken place with the source of the Satlej. Formerly, he says, the river from Maryum-la and *via* Gunchu-tso was the source of the Satlej. 'So we regarded the Tokchen river, with a course of about 30 miles, as the prime source. Now, so far as this question has not been thoroughly examined by anybody at the very place, this argument has no value whatever. For, the fact that Alexander Gerard, who never visited the place, creates the salt lake of Gunchu-tso as the source of the Satlej, is no argument. Then, talking of the Tage-tsangpo, he says: "another link in the chain is giving way between Rakastal and Tirthapuri, and when this process is complete, and the Manasarovar basin is quite cut off from the Sutlej, another source will have to be found. As I have shown in the previous chapter this view is perfectly correct: as soon as the lakes are completely cut off from the Satlej, — but not a day earlier! — another source will be found, probably the Darma-yankti. So, as he agrees with my view in this, the cardinal point of the whole problem, the rest of his discussion is superfluous. But the conclusion, at which he arrives, is surprising: Indeed, if we accept Dr. Sven Hedin's own definition, we cannot even now locate with certainty the genetic source of the Sutlej.' But, in the preceding passage, he had accepted my definition. So long as the lake basin is not completely cut off, it must belong to the Satlej, and as soon as it is quite cut off, it will have to be regarded as a self-contained (abflussloses) basin with salt lakes in its lowest part, of the same kind as those which are so very common on the highlands of Chang-tang. This stage in the development has not yet entered, and until it comes we have to content ourselves with the actual state of things and to describe and define the physico-geographical phenomena as they are and not as they may happen to become in a near or distant future, if one or the other eventuality should take place. For of the present state of things we know, of the future we can only guess. Prognostications are always allowed, but compared with observations they have no value at all.

Captain Rawling asks: What is a source?² And answers: 'I maintain, though it is possible I am in error, that it is the longest visible branch of a river system, and, if there are two branches of equal length, then that which carries the most water at its greatest flood.' This is not the place to discuss the definition of a source. Professor SUPAN³ shows that no general law can answer the question: where is the source? Every river system has a character of its own. If really, which is

¹ Geographical Journal, Vol. XXXIII, April 1909, p. 427.

² Geographical Journal, Vol. XXXIII, April 1909, p. 424.

³ In his *Grundzüge der Physischen Erdkunde*, Leipzig 1908 p. 705, SUPAN says that E. WISOTZKI is right, (Hauptfluss und Nebenfluss, Stettin 1889) »wenn er den Satz aufstellt, dass kein einzelnes Moment, wie Länge, Wassermenge, Breite, Tiefe, Farbe, Richtung u. dergl. ausreiche, um in jedem einzelnen Falle mit Bestimmtheit Haupt- und Nebenfluss zu unterscheiden, sondern dass man das ganze Stromsystem in allen seinen Beziehungen betrachten müsse; nur ist damit keine exakte Regel gegeben, und der Natur der Sache nach kann eine solche auch nicht gegeben werden. Denn ausserordentlich

not proved, the Chu-kar carries more water than the Satlej at the junction, this fact alone is not sufficient to decide the problem in favour of the Chu-kar.

But there exists really an individual feature in the case of the Satlej. If standing at the junction of the two rivers, and even knowing the volume of every tributary from the Himalaya forming the Chu-kar, and of every one from the Trans-himalaya forming the Tirtapuri branch, we should feel uncertain. Which is the head river and which the tributary? The Chu-kar or the Tirtapuri branch? Then I should, without hesitation decide: the one, which so long as records exist, has been called Satlej by the natives, must be regarded as the head river. The Tirtapuri branch is called Langchen-kamba by the Tibetans and was called so already when the Lama surveyors visited the place. And Langchen-kamba means Satlej, and was supposed already in old legends to issue from the Elephant's mouth. The Langak-tso or Lang-gak-tso is the Elephant's lake, or with a variation the Bull's throat, in which case the river is the Big Bull's river. Already in the names, the solution of the problem is found. They may have been given, originally, at an epoch when the river flowed out of the lake. But there may formerly have been periods when the lake was superficially cut off from the river, as is now again the case. But the names remain, independent of physical changes and pulsations. And a new rise in the hydrographical curve in a near or distant future may cause a new direct out-flow from the Rakas-tal. I do not mean to say that popular legends or religious prejudices should decide in a matter like this. But when they, as in this case, agree with hydrographical laws and scientific deductions their weight is very great. We shall see that both in the case of the source of the Brahmaputra and that of the Indus the native view is the correct one. In such difficult matters as these the opinion of the natives is often sounder and more reasonable than all the complicated dogmatism of European scholars.

It can be promulgated as a general rule that all the great rivers of Asia coming down from Tibet have their sources in glaciers. A glacier is an eternal source in store, even if it feeds the river only during some four months in summer. So is the case with the Darma-yankti-Chu-kar. And so is the case with Tage-tsangpo. But the latter river has a double reservoir *en route*, the Manasarovar and Rakas-tal.

mannigfaltig ist der Bau der Flusssysteme, von denen jedes seine individuellen Zuge hat die sich nicht in ein allgemeines Schema einzwängen lassen . . .

A second great authority I should like to quote is Professor HERMANN WAGNER of Gottingen. He says: „Talseen sind Ruhepunkte in einem Stromsystem; es ist ein und derselbe Fluss, der in den See eintritt und ihn geläutert verlässt. Dagegen bezeichnen Quellseen die Geburtsstatte des Hauptstromes, der mit dem Austritt aus diesem erst seinen Anfang nimmt. Die Versuche, einen von der Randabdachung dem Quellsee zustromenden Fluss als wahren Ursprung des den See verlassenden auszurufen, können vom wissenschaftlichen Standpunkt nur dann Erfolg haben, wenn die Wasserfüllung des fraglichen Sees als eine Schöpfung des Beckenrandflusses nachgewiesen wird.“ Lehrbuch der Geographie. Hannover und Leipzig 1908. Band I, p. 446.

I believe that in this case we do not need any general rules. The wisest would be to say, with Professor Supan, that every source lake or valley lake has, as the river systems, individual features of their own, and that they cannot be forced under any written laws.

In this reservoir the water of the upper Satlej is kept in store. Occasionally, when the evaporation is stronger than the precipitation, the reservoir will not be in function. But, periodically, when it, on account of heavy precipitation, becomes filled to its brim, the superfluous water must needs overflow. Where does it flow to? To the Tirtapuri Satlej! Thus the lakes must be reckoned to the Satlej system. If not, they must either belong to some other river system, or be self-contained. The first alternative is absurd, the second has so far not arisen, as the lakes are fresh, and as underground water very likely filtrates from the western lake to the Tirtapuri Satlej above Dölchu. Thus the lakes must belong to the Satlej.

Some people may always say: The Darma-yankti-Chu-kar is the head-river and source of the system, but the Satlej comes from Rakas-tal. I should prefer to give up all discussion with them as a hopeless task.

Even during the very year of my visit to the so much debated region, and the year after, before I had published any account of my exploration, nobody really knew where the source of the Satlej was to be placed on the map. The *Gazetteer of India, 1907*, says: »The Sutlej rises on the southern slopes of the Kailas mountain, the Elysium, or Siva's paradise, of Sanskrit literature. It once issued from the sacred lake of Manasarowar, still the resort of nomadic Tibetan shepherds . . . Emerging from the Kailas foothills at a height of 15,200 feet above sea-level, the Sutlej first traverses a plain with a S.W. course . . .¹

In 1908 the same work has removed the source of the Satlej, saying: »Rising near the more westerly of the Manasarowar Lakes in Tibet in 30° 20' N. and 81° 25' E., at a height of 15,200 feet, the Sutlej flows in a new direction along the southern slopes of the Kailas mountains to the Chinese frontier outpost of Shipki.² Even so late as 1908 it was impossible to decide the position of the source definitely. On some parts of a map in *The Gazetteer*, the hydrography of Tibet is still taken from d'Anville.³

In his standard work on Tibet Professor NIKOLAI KUEHNER gives an excellent and very conscientious description of the lakes and sources of the great rivers. The actual state of things he has chiefly got from Ryder, Rawling and Sherring. Of the Indus he says that it is formed by two branches, the northern coming from the N.E., the southern from the western »slopes of the massive Gangri, near the peak Kailas», where, in a skilful way, he eliminates the general mistake that the river should come from Kailas itself. Of the Satlej he says: »At present the source of the Satlej is to be found at the monastery Dalju, where a great spring exists, though the dry bed continues further to the lake Rakas-tal, and here and there in it water is to be found. The natives of the place unanimously assert, that along the whole

¹ The Imp. Gazetteer of India. Vol. I, New Edition, Oxford 1907, p. 3. The »birthplace» of the Brahmaputra is here, p. 27, given »near the eastern base of Kailas.»

² Op. cit. Vol. XXIII, p. 178.

³ Op. cit. Vol. XXVI, Atlas No 4, 1909.

course underground water is streaming under this bed, and that this water at some places shows itself at the surface. There can be no doubt that during periods of strong rains the whole above-mentioned bed may be filled with water which joins the Rakas-tal with the Satlej-source at Dalju.¹

So far I have proved that the Satlej comes from the Rakas-tal, even if the present period marks a depression in the hydrographical curve. The next question is: from where does the water come to Rakas-tal? One river, flowing west of Parka, comes from Tseti-la and Tseti-lachen-la in Transhimalaya and receives a tributary from the Tse-lung valley east of Kailas. Another, periodical as the outflow from Rakas-tal comes from the Manasarovar. The first is 26 miles as the crow flies, the latter 47 miles. As shall be proved lower down, it would be absurd to call the Parka-river the source and head of the Satlej, and the Ganga or channel from the Manasarovar a tributary. For if we admitted the Parka river to be the head river, and then ask the Tibetans to show us the Langchen-kabab or Elephant's mouth, we should, at any rate, not be brought to the Tseti-la or Tseti-lachen-la.

Already the Lama surveyors represented the river Lanctchou, which lower down passes Tchoumourtzi (Chumurti), as flowing through the Manasarovar. So did Father Gaubil (Vol. I, Pl. LIII), and Father Tieffenthaler (Vol. I, Pl. LII), though he had unreliable references or misunderstood the information given to him. The two Fathers had never been at the place, but the Lamas had.

Having followed up the river so far, the next question will be: As the Satlej flows *through* the Manasarovar, where is its upper course, or which of the affluents to the lake will have to be regarded as the origin of the Ganga channel?

The Mansarovar is a valley lake as it is fed from north, east and south. Amongst all these affluents the Tibetans and Lama surveyors have selected *one*, which they have called the source of the Satlej. Regarding the Satlej as coming out of the Manasarovar, the most correct way would, perhaps, be to say that the Satlej has as many sources as the Manasarovar has affluents. But then, under all circumstances, we shall be allowed to call one of these sources the principal source of the Satlej.

Then the next question is: which of the affluents should be selected? Obviously the one which brings the greatest volume of water to the lake, and which contributes in the greatest extent to fill the lake basin, although the lake is perhaps filled more from under ground than superficially. Tage-tsangpo is nearly four times as big as any one of the other affluents. Tage-tsangpo is, further, the longest of all and it is fed by glaciers and eternal snow. And, as I found long before I had ever thought of the Satlej problem, about half-way between the source and the mouth of the Tage-tsangpo there is a spring which is regarded as sacred, and which is called Langchen-kamba, a word that means Satlej, the river from the Elephant's

¹ Opisanie Tibeta; Vol. I, part 2: Ocherk fizicheskoy geografii Tibeta. Vladivostok, 1907, p. 65 et seq.

mouth. So the result at which I arrived by hydrographical deductions was perfectly corroborated by the opinion of the natives.

The uppermost Tage-tsangpo is formed by two branches. The northern one, which originates from the Tamlung-la (17,382 feet) is a mere brook. The southern, Ganglung-chu, which comes from the Gang-lung glacier, is more considerable. There can be no doubt as to which of these two is the most important. Of course the one which is longest, which has the greatest amount of water, which originates from the greatest absolute height and which is fed by glaciers. This is the case with Ganglung-chu and therefore the source of the Satlej is situated at the mouth of the Ganglung glacier, which was clearly visible at a distance of some nine miles south of my route over Tamlung-la.

In my earliest reports I called this source »the genetic source of the Satlej . But having examined the problem now, I think the best term would be: the real and principal source of the Satlej at the present epoch.

The Ganglung glacier is fed by eternal snows and *nevées* on a mountain massive, called Ganglung-gangri and which is a link in the gigantic chain to which Gurla-mandata and Kubi-gangri belong. This Ganglung-gangri, or »Ice mountain of the glacier valley» is called, on d'Anville's map of April 1733, Mont Lantchia Kepou, which is a corruption of the Tibetan Lanchen-kabab or Elephant's mouth.

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CHAPTER XXI.

THE LATEST PULSATIONS.

In the following chapters of this volume I will give a description of my own observations round and on the lakes. For the sake of the continuity of the chain, let it be sufficient to say that I found the channel between the lakes dry, except some stagnant pools of water and that I found no superficial water running out of the Rakas-tal. This was in 1907. The Lamas of Chiu-gompa told me the channel had been dry the last 4 years and a Lama of Dölchu-gompa told me the Satlej had been dry since 1863. Such information is, as a rule, very unreliable, as the natives seldom know even their own age. In 1908 the situation was the same, in spite of more rain.

It may be regarded as certain that the post-glacial desiccation is still going on. It proceeds very slowly and the question is not yet settled whether historical data suffice to prove the rate of desiccation. Nobody knows how long it will continue. But it will probably, sooner or later, reach a climax, after which a new wet period may set in with the same slowness. For the cause of the great ice age is still unknown, and a new ice age may set in in a distant future. So long as the desiccation still continues, our lakes must dwindle. But their dwindling is not gradual and regular. There is a second or third order of periods, so that the lakes occasionally rise again.¹

I did not believe that this presumption would prove to be correct, or at least partly correct, so soon as now seems to have been the case. For the first link in the broken chain has lately been joined again and was in function 1909 to 1911.

In the spring of 1911, I wrote to KHAN BAHADUR GULAM RASUL, the great merchant of Leh, who owns the monopoly of the Lopchak mission to Lhasa, and who every year sends caravans between Leh and Lhasa and has a branch at Gartok and Gyanima, — and asked him if he could provide me with some news about the

¹ "Trans-Himalaya," Vol. II, p. 187. With this view I wrote, as quoted above: Tso-mavang may rise so that its water may again flow through the channel to Langak-tso, and this lake at length may discharge its surplus water, as formerly, through the dry bed of the Sutlej.

channel between the lakes. To this he answered from Leh, June 12th 1911, literally as follows:

I. There was a great deal of rain in the autumn of 1909 at Gartog. But in the whole autumn of 1910 there was more rain than the year of 1909 in all the places of Chang-thang, and was wet for nearly 3 months. By cause of heavy rain brooks were as great streams and dry brooks were also as streams and rivers. By crossing of such streams and new rivers some men and tea loaded poneys died by the struck of rushing water. In the same season there was also a rushing stream in the brook of Cheu-gompa, as I heard it in Chang-thang.

II. All the traders and caravans from Leh to Yarkend goes by the way of Morgho on the East. They also passed by the way of Morgho in 1909 and 1910, as it is impossible to travel by the way of Kholmダン, the glaciers closed the road.¹

III. (A) In the autumn (Aug. & Sept.) of 1909 and 1910 some water flowed in Langag-tso from Mawang-tso.² (B) In the last winter (February 1911) a reliable Lama Inhabitant near Langag-tso came in Leh, and as I ascertained he answered thus: 'It is impossible to run out water from Langag tso to any direction, because it stands lower and it is rounded by mountains as a fort with wall.'

But I think these words are not sufficient for you and for your book; therefore I will send our reliable man to Cheu gonpa & Langagtso, after his return we will write you in details about them.

More than a month later I received, unexpectedly, the following communication from the British Trade Agent at Gartok, RAJ BAHADUR THAKUR JAI CHAND, dated July 7th, 1911:

»I learned from Khuaja Gulam Rasul of Ladakh that you asked information regarding the lakes Mansarovar and Rakas Tal and I have the honour to reply as follows: The two lakes have not joined but owing to excessive rain in the two preceding years,³ the channel joining them had expanded considerably, but it has now come to its former width.«

Both these distinguished orientals, who did me invaluable services during my last journey in Tibet, are perfectly reliable men, and the fact that they tell the same story puts the situation beyond doubt. Gulam Rasul first talks of a »rushing stream» in the channel, and then he says that »some water» flowed from the eastern to the western lake. From this it is clear that there must have been a communication in 1909 and 1910, although it is impossible to draw any conclusions as to the dimensions of the water-course. Thakur Jai Chand says that the channel joining the lakes »had expanded considerably» in 1909 and 1910, but »come to its former width» in July 1911, which obviously means that it then was dry. For it is likely that even in years of outflow, the channel is in function only during the wet season, August and September. Thakur Jai Chand's report is, however, less clear than that of Gulam Rasul, which may be owing to the circumstance that he had not been asked to give me information.⁴

¹ I have given the original as it is, without improving the grammatical slips.

² It is worthy of attention that he writes Mawang, and not Mobang, Mapam etc., which may, however, depend on the fact that I wrote Tso-mavang in my letter to him.

³ 1909 and 1910.

⁴ As soon as I got their letters I wrote again and asked for more detailed reports, if possible some measurement on the bridge at Chiu-gompa, as well as some information for the autumn of 1911.

The fact that water had begun to stream, in 1910, from the Manasarovar to the Rakas-tal, proves that one link in the chain had been joined again, and that only one interruption existed, namely, between the Rakas-tal and the Tirtapuri Satlej.

In the late autumn of 1913 I received a new letter from Gulam Rasul, in which he informed me that he had sent a reliable man to have a look at the two lakes and the brook. This man returned to Leh about the middle of October and on the 20th of October, 1913, Gulam Rasul wrote a letter to me, containing the following information:

I. In 1911 there was a lot of rain in Chang-thang, by cause of which the water of Mawang-Thhsso ran into the Langag-Thhsso through the way of Gang-gi Grogpo.

II. There was no rain in Chang-thang in 1912. By that reason the two lakes not joined together as in 1911. And there was no good grass produced in the surroundings.

III. In 1913 there was only a little rain in the beginning of summer, and there was a good deal of rain in the end of summer, but Mawang has not got any chance in this year to go and meet with Langag, and Gang-gi Grogpo was dried and empty.

IV. The western lake, Langag-Thhsso, does never flow into the Tretapuri-Satlaj.

According to this latest information the links in the chain are again isolated from each other. Even the considerable rains in the late summer of 1913 were not sufficient to give rise to an effluence from the Manasarovar.

I have not been able to trace the hydrographical pulsations of 1914 and 1915, as the war has interrupted my correspondence with Gulam Rasul.



CHAPTER XXII.

SURROUNDINGS OF THE MANASAROVAR.

The pass Tamlung-la or Tag-la is important as being the watershed between the great Tsangpo and the Satlej. Its height is 5,279 m. (17,315 feet). It is very easy, being situated in a flat moraine consisting of granite in several different varieties. The intermediate spaces between the blocks and gravel are often filled with grey and yellowish sand which also sometimes covers the ground with a thin layer. The configuration of the ground does not allow the formation of dunes. On both sides of the pass are several pools which may be regarded as the remains of old moraine lakes.

Tamlung-la is only a threshold in a longitudinal valley. The view is comparatively open. To the south are those gigantic mountains belonging to the Ladak range between Gurla-madata and Kubi-gangri. To the S.S.W. the two ridges, between which the Ganglung glacier is situated, are only partly visible. This glacier is the source of the Ganglung-chu, which lower down is called Tage-tsangpo, the uppermost part of the Satlej, even if it periodically may be cut off from the river below Dölchu-gompa. The brook beginning from Tag-la is called Tage-tsangpo, a name that is used for the joint river the whole way down to the lake. The narrow valley of this river, which is visible to the N. 77° W. is also called Tag. The mountains to the N.W. being a part of the ridge separating the Tag valley from Gunchu-tso, are, at least partly, called Chumik-ri. S. 38° W. is a mountain called Hlalung, and to the west is an isolated mount called Dogri, to the left of which one gets a glimpse of Gurla.

The longitudinal valley is broader to the west of the pass than to the east, where several ramifications may easily give the impression of a transverse ridge of the shape as on Ryder's map. At a place called Chian-karpo the road from the pass first comes in contact with the Ganglung-chu, just where it pierces an old moraine in a wild and noisy cascade.

At camp 207 Tage-tsangpo carried July 20th, 1907, only about $1\frac{1}{2}$ cub. m. a second, but on the way to Tag-ramoche it soon grows bigger on account of

several tributaries from the snow and ice mountains in the south, of which many appear in the form of springs. One of these comes from a considerable glacier, visible between its black mountain spurs not far off, another from the mountain group of Tünjom. The whole valley is a typical moraine landscape. Heaps and labyrinths of moraines are visible the whole way to the hard rock in the south. The material is granite, gneiss, black crystalline schist etc. Where Tage-tsangpo breaks through the moraine walls, it forms rapids, otherwise it is streaming quietly.

The most prominent mountains visible from Tag-ramoche are: to the S. 65° E. the Memo-gangri, S. 52° E. Ganglung-gangri, S. 38° E. Hlalung, S. 25° E. Dunjum-pu, S. 10° E. Panglung with a glacier and snow-fields in the background, and south, Panglung-chonga. To the S.W. the mountains of Dogri or Dugri are situated, and to the north Membar-chunga.

The narrow valley of the Tage-tsangpo is called Tage-bup. Here the moraines have sometimes been swept away and the ground is covered with light sand, sometimes forming rudimentary dunes, sometimes bound by grass. For a certain distance the river is swollen as a long narrow lake with an extremely slow current, after which the Tage-tsangpo again becomes narrow and rich in rapids. The mountains are steep on both sides and the valley energetically cut out. One gets the impression that a considerable river must once have eroded this valley, and, before having made any measurements or read any Chinese accounts, I wrote in my diary: »The Tage-tsangpo must be the genetic source of the Satlej, even if the diminished precipitation of a later period has cut it off from the present Satlej.» Another proof was found when passing the two springs Langchen-kamba and Chako, the thermometer registering 3.5° and 4.6° C. resp. of their water. When writing down these names I had not yet heard that Langchen-kamba or The Elephant's river was the Tibetan name for Satlej. The mountain at the foot of which the two sources are situated is called Chumik-ri, or the »mountain of the source».

The rocks on both sides of the valley consist of serpentine, crystalline and ordinary limestone and sandstone. A little below the point where the Tage-tsangpo goes out into the open basin of the Manasarovar the valley of Tagdung, coming from S. 25° E. and surrounded by considerable mountains, joins the Tage-tsangpo. Sinchen and Sinchung are two smaller valleys to the S.W., and Laptsa is a valley from S. 50° W. coming from Gurla-mandata or Memo-nani, which is visible in S. 73° W. At Camp 209 there is a pool called Tso-nyak. From the road between Tamlung-la and this place one gets a very insufficient view of the complicated mountains farther south. This region promises very interesting discoveries to future travellers.

Between Camps 209 and 210 the country is again rich in moraines. The bed of the Tage-tsangpo is also full of blocks and gravel. The river, where our road crosses it, is divided in two branches, which at high water become united. On July 22nd their dimensions were: breadth 20.00 m., average depth 0.27 m., average velocity 0.71 m. and volume 3.89 cub. m. a second; and the second branch: breadth

25.56 m., average depth 0.34 m., average velocity 0.50 m. and volume 4.37 cub. m. a second. Thus the river carried 8.26 cub. m. a second.

A little north of the crossing point is a broad, open valley called Na-marding, with a brook going to the Tage-tsangpo. Anak and Lingur are small valleys in the neighbourhood. Some strange terraces are seen round Na-marding with perfectly flat surfaces; they cannot possibly have anything to do with the lake, as they are more than 200 meters over its present surface.

The road from Na-marding to Tokchen crosses a series of rolling hills sloping down to the lake, and several ravines between them. Quarzite, sandstone and conglomerate predominate, but only once is sandstone found *in situ* dipping 21° N. 75° W. The gravel is often wind-worn; no erratic blocks could be seen. A little quite secondary pass, Karpo-la, is 4,888 m. (16,032 feet) high. From these hills the road goes finally steeply down to the valley of Samo-tsangpo, which, to judge from Ryder's map, gets most of its water from the mountains south of Surnge-la. Tokchen, on the *tasam*, is not always situated at the same place. When I passed in 1908 the tents of Tokchen were pitched some 3 miles higher up in the valley. On July 25th the Samo-tsangpo carried only 0.73 cub. m. a second with a breadth of 11.5 m. On July 23rd, the following year, it carried 4.89 cub. m., with a breadth of 21.9 m. But in 1908 the rain was much more abundant than in 1907.

Just south of the point where Samo-tsangpo enters the lake the breadth of the almost horizontal shore plain may be 200 or 300 m. This plain becomes more and more narrow to the south, but widens out very considerably to the north. South of the river the plain is bounded to the east by a wall of gravel, and inside of it is a belt of vegetation hills or low earth-cones, bound by roots, in sand.

A little north of the mouth of Samo-tsangpo is a comparatively great lagoon, surrounded by swamps and excellent grass. Between the lake and the lagoon is a narrow neck with a wall of gravel, some 3 m. high. The lagoon and its swamps are fed by the rivulets coming down from the valleys Pachen and Pachung, both originating from the southern slopes of the Transhimalaya, west of Surnge-la.

The Pachen leaves its rocky valley at a height of 4,696 m. (15,402 feet). The mountains consist of phyllite and sandstone dipping 24° N. 80° E. On August 19th, 1907, the Pachen carried 1.98 cub. m., but a mile below the mouth of the valley only about half as much, which was on account of the water disappearing in the gravelly ground and reappearing again round the lagoon as springs.

A few miles (5.3 km.) farther west the Pachung leaves its valley, which in every respect is very like its Pachen neighbour. The same day the Pachung carried 2.36 cub. m. After having left the rocky valleys, the two rivulets cross the scree of gravel and sand at the foot of the mountains, which slowly go over into undulating ground, steppe, and vegetation cones. Finally they enter the lagoon, which also receives a small brook of 0.5 cub. m., called Lungnak, from another lagoon situated a little to the west of the first. The eastern lagoon thus received

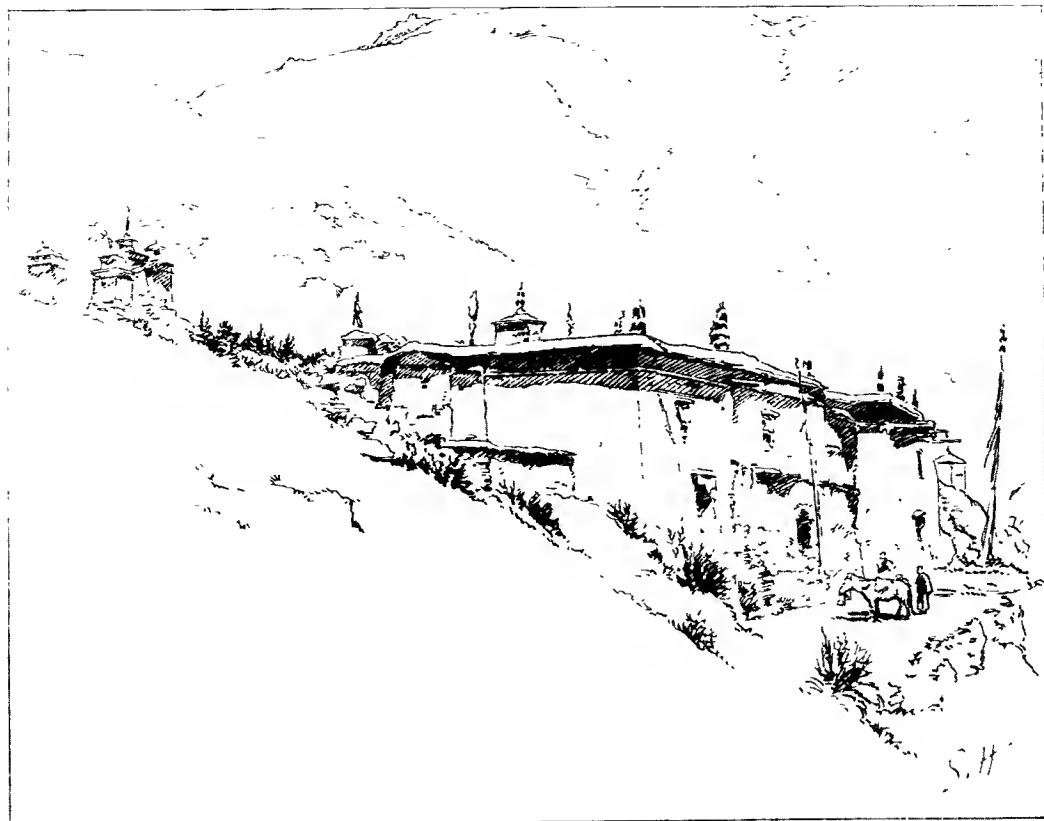
4.84 cub. m. a second, on August 19th. But the following day only 1.76 cub. m. left the lagoon in the little brook which pierces the gravel wall near the shore. This depends of course partly on evaporation from the lagoon, partly on the fact that a considerable volume reaches the lake in the form of springs under the present level of the Manasarovar. The effluent is perfectly clear, as the material brought down by the feeders is left in the lagoon. Therefore no piers or sandy necks and capes are formed at the mouth of this effluent, which, on the other hand, is the case where the Samo-tsangpo enters the lake.

Between Camps 220 and 221 the shore of the Manasarovar is very regular and hard. At the edge there is a lagoon the whole way, only 2 or 3 m. broad and separated from the lake by a very narrow neck of mud. At Camp 221 there is, inside of this uninterrupted shore-lagoon, a belt of mud 164 m. broad. Then follows the gravel wall, 2.5 m. high. At its foot, and 1.25 m. above the surface of the lake is a *mani*, the flat stones of which seem to have been worn for some considerable time. This *mani* must be under water during years when a considerable effluent leaves the lake. Inside, or north of the gravel wall, there is a dry depression, parallel with the shore; its bottom was nearly at the same level as the surface of the lake.

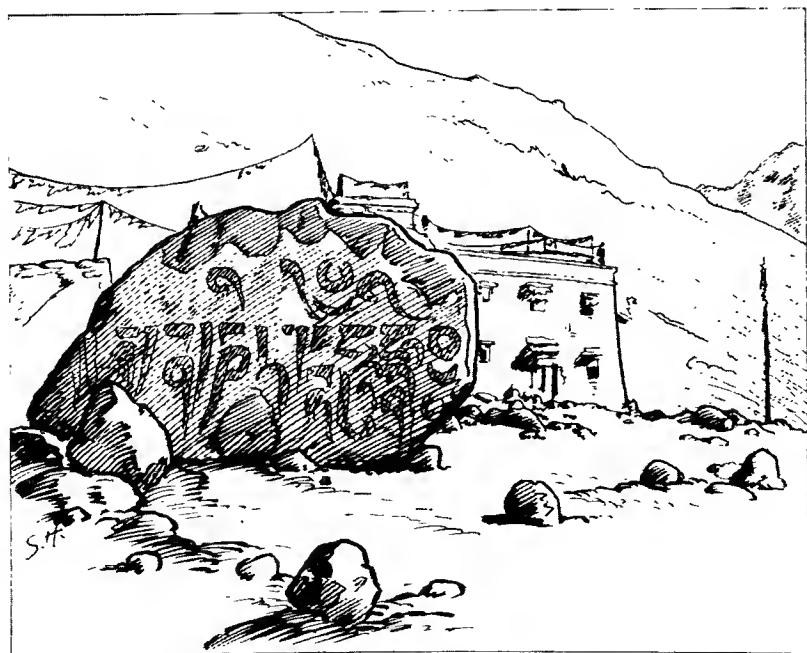
The distance between the northern shore of the Manasarovar and Pundi-gompa on the first mountain-spur is $8\frac{1}{2}$ km. The rise to the foot of the mountains is extremely slow and can hardly be noticed without instruments. The grass is very abundant and of unusually good quality, as the ground is sand, and the level of the underground water is near. Sometimes it is even visible as open pools. The western lagoon is close to the east of this track, which crosses the Lungnak brook, a water-course that seems to be fed chiefly from springs. Animal life is represented by hares, falcons, ravens and kyangs. As soon as the rise to the foot of the mountains becomes more considerable, small vegetation cones and steppe plants appear instead of the grass. Finally the gravel scree is reached and a very steep road leads up to Pundi-gompa at a height of 4872 m. (15,980 feet). The rock *in situ* consists of sandstone, conglomerate, a sandstone breccia and quartz-conglomerate in 59° S. 50° W., — although not quite clear.

The track from Pundi to Camp 222, or 11.3 km. due south-west, crosses a region of nearly the same character as the line just described: gravel, steppe and grass-plain. Round or oblong pools, about 20 m. across, are more numerous. The Lungnak brook is again crossed. Langbo-nan-gompa is situated on the right, or western bank of Gyuma-chu, which, on August 21st, 1907, carried a volume of 2.09 cub. m. at a breadth of 16.5 m. Where this river reaches the lake it has formed a typical delta, though of very small dimensions. There are several lagoons between the different branches, and outside of the delta is a rampart of mud. Very likely this delta becomes visible only when the surface of the lake is falling as in 1907. When the Manasarovar sends an effluent to Rakas-tal, as in 1909 and 1910,

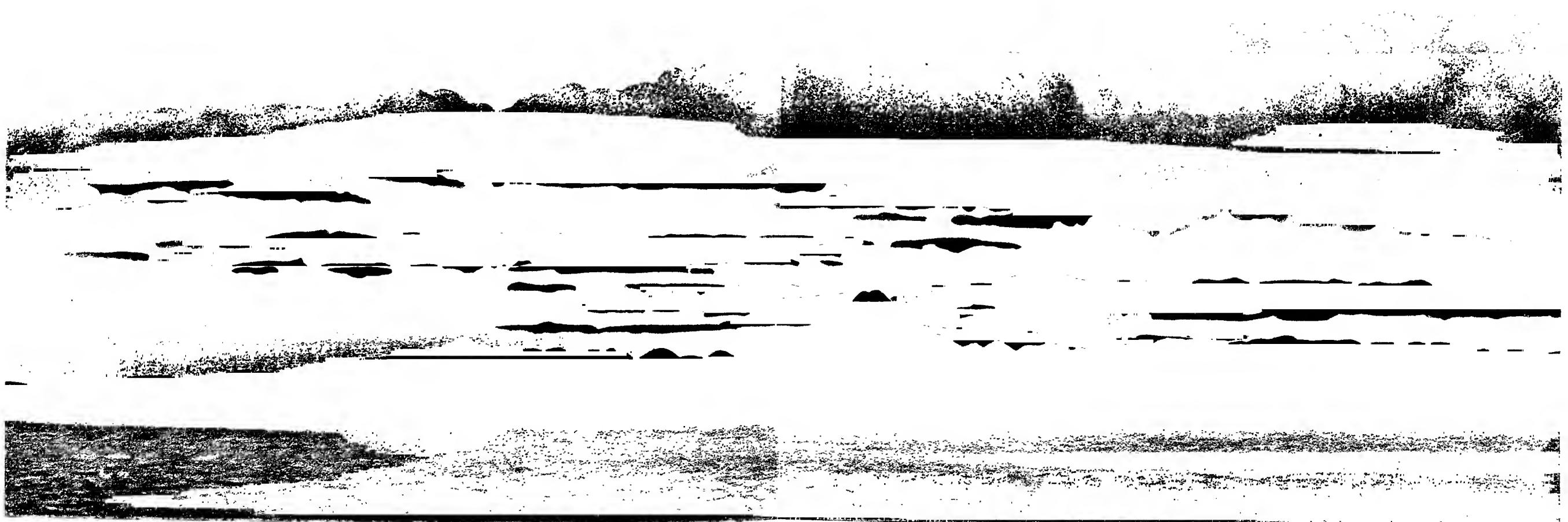
VOL. II.



PUNDI-GOMPA. LOOKING N 30° O.



DIRIPU-GOMPA.



THE KAILAS AS SEEN FROM TUGU-GOMPA A SUMMEREVENING AFTER SUNSET

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the delta must be inundated and hidden. To some extent it may depend upon the material brought down by the Gyuma-chu that the lake is more shallow outside of the delta than, for instance, south of Camp 221. At Camp 222 the gravel wall along the shore had a height of 3.10 m.

Leaving Langbo-nan and proceeding westwards to Chiu-gompa one has to follow close along the shore, for here the mountains reach the very edge of the lake, and only leave a very narrow passage open to the road. The ground is full of blocks and gravel, everything worn round by the action of the waves. The first solid rock is diabas in 30° N. 80° W., and a little farther on sandstone in 59° N. 55° E. The rocks are very steep, even perpendicular, and at their foot a series of grottoes has been caved out by the waves, as may be easily seen from their rounded forms. Along the foot of the rocks is a belt of vegetation. Several deep-cut ravines pierce the rock-front. Their slopes are often covered with clay, sand and detritus, in which the rain has modelled out curious steep pyramids and cones. On the top of some of these pyramids there is a flat block, showing that they have been formed almost in the same way as glacier-tables, the block protecting the underlying soft material from destruction.

The gravel wall is only feebly developed along this part of the shore. The breadth of the open space between the foot of the rocks and the water-line is about 20 or 30 m. At a very narrow place a road is seen crossing a little mountain spur. It must have been in use at a time when the surface of the lake stood 1.75 m. higher than now. At the present low water level it is superfluous. In a short open valley Chergip-gompa is situated on a terrace. West of it the rock is sandstone and crystalline schist in 14° N. 20° W. Farther on phyllite appears in 37° N. 20° E. Generally the fall is towards the north, but very irregular and the rock much folded. At the promontory with a *chorten* from where Chiu-gompa is visible, limestone again appears falling 10° towards 38° N. From here to Camp 219 at the foot of Chiu-gompa the open shore plain becomes a little broader.

In 1908, when there was much more rain than in 1907, the hydrography along the northern shore of the Manasarovar was somewhat different. Only the lagoons at the N.E. corner were about the same. But the effluent from the eastern lagoon had, on July 25th, a volume of 5.25 cub. m., instead of 1.76 on August 20th, 1907, and its breadth was almost exactly 100 m. The Gyuma-chu had 4.01 cub. m., instead of 2.09 the year before. It is obvious that such great differences in affluence to the Manasarovar from one year to another must in a very high degree influence the height of the water level. In 1908 the lake must have received at least twice as much water as in 1907, or probably more, as 1908 brought a good deal of rain, and 1907 hardly any at all. The two following years, 1909 and 1910, the precipitation was still increasing and made the lake overflow through the channel into the Rakas-tal.

The road from Tokchen to Serolung-gompa follows the Samo-tsangpo downwards for a while, leaves the river to the right, and climbs the steep hills at the

left side of the valley, where 3 fluvial terraces, each about 3 m. high, are distinctly visible. The rest of the way goes up and down over hills and more or less deep-cut ravines. In the largest of these ravines Serolung-gompa is situated at a brook which soon disappears underground. At Camp 212 the open level plain between the water-line and the foot of the hills is only 84 m. broad. Just above the Camp, where the hills are very steep, six terraces or old beach-lines are faintly visible, the highest being 49.5 metres above the surface of the lake. It is difficult to account for them, without a very detailed survey being undertaken all round the lake. Only the highest of the 3 above-mentioned terraces in the valley of Samo-tsangpo may be attributed to the lake and not to the river, as a certain divergence appeared to exist between it and the two lower terraces. At Na-marding I have mentioned some terrace formations with perfectly horizontal surfaces. The difficulty is to bring these old remainders in accordance with the erosion in the valley of the effluent from the Rakas-tal. The basin of both lakes may, however, have been filled with æolian deposits during a dry period of steppe climate, simultaneous with the period when the great *loess* deposits were formed in China and Mongolia, and the valley of Guge was also filled. During the fluvial period which must have been contemporary with the ice age in the north, the rivers broke their ways through these soft beds. As soon as the valley of the effluent was established, the surface of the Manasarovar cannot possibly have stood more than a few, perhaps 3 or 4 m., higher than now, as the lake was constantly drained by the effluent. But as I said before this problem can only be solved after a very detailed examination of the whole region round.

Following the shore by boat south-westwards from Serolung-gompa one sees how the last hills along the lake become lower, until they are hardly more than 10 m. high near the mouth of Tage-tsangpo. At certain intervals ravines open out to the lake, most of them dry in 1907. The lake is shallow the whole way and the isobathe of 1 m. is about 50 m. from the shore.

Tage-tsangpo enters the lake without forming a delta; but at the right side of the mouth there is a long, narrow cape with a mud island in its prolongation. At the left side there is another mud island in the form of a crescent. Even now, in spite of the dry summer, the water of the river was rather muddy, which, however, does not depend upon the fact that it is chiefly fed by glaciers, for at Lang-chen-kamba the water was very clear, pointing to the fact that it does not come direct from the glaciers, but probably passes some moraine lakes or becomes filtered in old moraines. The dimensions of the river were now: breadth = 17.30 m., average depth = 0.727 m., average velocity 0.911 m., and volume 11.26 cub. m. a second, on August 1st, 1907. Thus it had nearly 3 cub. m. more than a few days earlier north of Tso-nyak. The difference did not depend on any changes of weather, but obviously on tributaries joining the river from the Gurla below Tso-nyak.

The river makes a very curious bend before entering the lake. Instead of reaching the shore at right angles, it turns off sharply to the north keeping parallel

with and at about 100 m. from the shore line. To this bend it is forced by the wall which here as well as along the northern shore follows the edge of the lake. At Camp 215 the wall was 4.12 m. high. Finally it is broken through where the river goes out into the lake. The valley of Tage-tsangpo comes from S. 88° E. and is well marked, although situated between rather low hills.

Farther south-westwards from Camp 215 the hills recede leaving the shore more open than before. The long narrow lagoons are like those along the northern shore. They are some 15 m. across and separated from the lake by a neck only 1 m. broad. The neck consists of sand and mud. These lagoons are to be found only where the shore slopes down very gradually. The neck is formed by the action of the waves and inside it the water is dammed and forms the lagoon. They will have to follow the rise and fall of the lake. Only at periods when the lake is unusually filled will they probably disappear altogether. Outside of them the bottom of the lake is covered with gravel and sand. Inside of the lagoons a line of dead algae proves that the lake has been falling during the last few years.

Not far S.W. of Tage-tsangpo the rivulet Nima-pendö enters the lake and forms a very regular and typical delta. Just after having pierced the beach wall the river divides in several branches, separated from each other by mud banks. Outside of the delta is a natural pier, broken through at six places. These passages are only about 1 m. broad and 2 dm. deep. Above the delta the river has very well marked and perpendicular fluvial terraces about 1 m. high. There are a few miniature sand dunes and comparatively good grass. The beach wall along the shore is 4 m. high. The river comes out from between low hills, where, on the right side of the valley, can be seen a terrace some 15 m. high and visible only towards the lake, but not up in the valley. Nima-pendö had, on August 2nd, 1907, a breadth of 11 m., an average depth of 0.163 m., an average velocity of 0.790 m. and a volume of 1.42 cub. m.

Farther south-westwards the hills, undulating, low, and yellowish, recede more and more from the shore. Between them the rivulet Richung-chu issues with 1.80 cub. m. of water. At Jango-gompa, which is situated on the same shore terrace as Tugu-gompa, the rivulet Richen-chu runs out into the lake, with almost the same dimensions as Richung. Hardly a kilometer from the shore, the Richen divides into three or four branches streaming over a very flat slope of gravel. At a narrow place the river had a breadth of 4.05 m., an average depth of 0.29 m., an average velocity of 1.5 m., and a volume of 1.76 cub. m., on August 5th. In the course of four hours, towards evening, the volume augmented considerably.

The western front corner of Jango-gompa was, on August 5th, 1907, exactly 4.5 m. above the surface of the Manasarovar. The façade is due east and west; the line at right angles from the west corner to the shore was 107.7 m; this line must in 1910 have been some 30 m. shorter.

A short distance east of Tugu-gompa the almost uninterrupted narrow shore lagoons begin again, separated from the lake by a mud-neck. This formation is characteristic for the whole south and west shore.

The northernmost point on the façade of Tugu-gompa was, on August 3rd, at a distance of 98.46 m. from the water-line of the lake. Beginning from the shore the first 55 m. were occupied by lagoons and wet mud and clay; the next 10 m. are dry clay; then begins the fine gravel and finally the gravel wall or terrace on the top of which the temple is built. The foot of the façade, at the western corner, was now 6.30 m. above the surface of the lake. One Lama pretended that 18 years ago, or in 1889, the lake reached the very foot of the façade, a piece of information which seems to be very unreliable.

On the section from Tugu to Camp 218 some changes take place. The lake is deeper; about 5 m., only some 50 m. from the shore. The scree of gravel and alluvia from Gurla goes down to the deepest parts of the lake. In the south one sees where the solid rock comes to an end and the greyish scree from every deep-cut valley and glacier passage in Gurla begins to spread and become broader and less steep as it approaches the lake. On the way down all these screes melt together more or less. Two brooks are seen coming out in white rapids from their rock valleys, but only one mouth is passed at the shore, being 11 m. broad and carrying 1.07 cub. m. a second. The other brook disappears under the gravel of the scree. In this way the Manasarovar receives a good deal of water that escapes control. At such places where the ordinary belt of lagoons is developed, a great number of springs appear in or just above the lagoons, which stand on clay and mud. But at places where the gravel and sand of the scree dip into the lake, and where no lagoons are developed, the springs appear from the bottom of the lake, as can be clearly seen from the boat. Outside of the lagoons no such springs are visible at the bottom. It seems probable that the water from melting snow and glacier ice flows over the top of beds of glacial clay, and through the deposits of gravel and sand which cover them and which are permeable. At places where the underlying clay appears on dry land the springs will therefore reach the surface a little above the shore, but where the scree dips into the lake they join the lake directly, at some distance from the shore. One can easily prove that this is the case. Making a hole with a stick through gravel or sand near the shore, one sees how it immediately gets filled with water coming from the south and slowly streaming to the lake on the top of the underlying clay. A more abundant spring near Camp 218 had a temperature of + 3.4° C. at the same time as the lake had 15° near the shore, proving that the cold glacier water keeps its temperature beneath the gravel on its way down.

Along some sections the 6 m. terrace reaches the very shore of the lake which in such cases is deep directly outside of them. A short distance east of Camp 218, the lagoons begin again and then continue northwards.

GRIEV-MANDATA FROM THE EASTERN SHORE OF MANASVARA.



The two largest valleys situated on the northern side of Gurla are called Namreldi¹ and Sälung-urdu. Riding up from Camp 218 to the first-mentioned, one has to cross some narrow belts of vegetation, and then the flat grey scree of gravel from Sälung-urdu furrowed by now dry water-courses diverging towards the lake. They prove that sometimes such powerful floods may come down from the mountain, that they keep on the surface almost the whole way down. A road from Tugu-gompa to Taklakar in Purang crosses the fan. Where this fan and that from Namreldi come in contact with each other, a low wall of gravel is formed.

Reaching the foot of the mountain one has to cross a rock spur on the eastern side of which one comes down into the Namreldi valley, a little above the point where it leaves the mountain and opens out to the fall with its regular slope down to the southern shore of the Manasarovar. The passage through which it goes out is as narrow as a gate, almost filled with the water of the river. So far as one can see, the valley is very narrow and wild; the snow-slopes of Gurla, which are so splendidly visible from the lake, are now hidden by the nearest parts of the mountain.

At noon, on August 12th, the brook had here a breadth of 9.43 m., an average depth of 0.28 m., an average velocity of 1.16 m., and a volume of 2.86 cub. m. Of this volume, as was found the day before, only 1.07 cub. m. reaches the lake on the surface of the earth, though the two measurements cannot be compared, as the Namreldi rises considerably towards evening. Its water is perfectly clear which seems to indicate that it does not come direct from a glacier. At this place and on the little spur west of it the rock is white and grey granite and gneiss-granite, dipping 29° N. 33° E.

For a distance of a few kilometers along the northern foot of Gurla, from Namreldi to Sälung-urdu, there is nothing but blocks, gravel and sand, sometimes covered with scanty vegetation. Everything is granite and gneiss. The Sälung-urdu comes from a glacier visible from the lake. The water is full of glacial clay. The breadth of this brook was 5 m., average depth 0.28 m., average velocity 1.29 m., and volume 1.81 cub. m. No superficial water reaches the lake. The brook had a temperature of 3.2° C., almost the same as in the springs near Camp 218. Looking northward to the lake one sees that the fans from these two valleys form convexities in the shore-line, and probably the varying depths in the southern part of the lake depend on the continuation and situation of these fans.

Following the shore northwards from Camp 218, we find the same long narrow lagoons as before separated from the lake by a low mud wall. The open space between the hills and the lagoons is very narrow. Inside of the lagoons is a bed of dead algae, then follows coarse sand and gravel rounded by the waves; on the slope of the hills there is a terrace some 4 m. high and above it some vegetation of small bushes. The lake is shallow at 50 to 80 m. from the shore and is here very muddy; one sinks to the knees if walking near the lagoons.

¹ Some Tibetans called it Namreling.

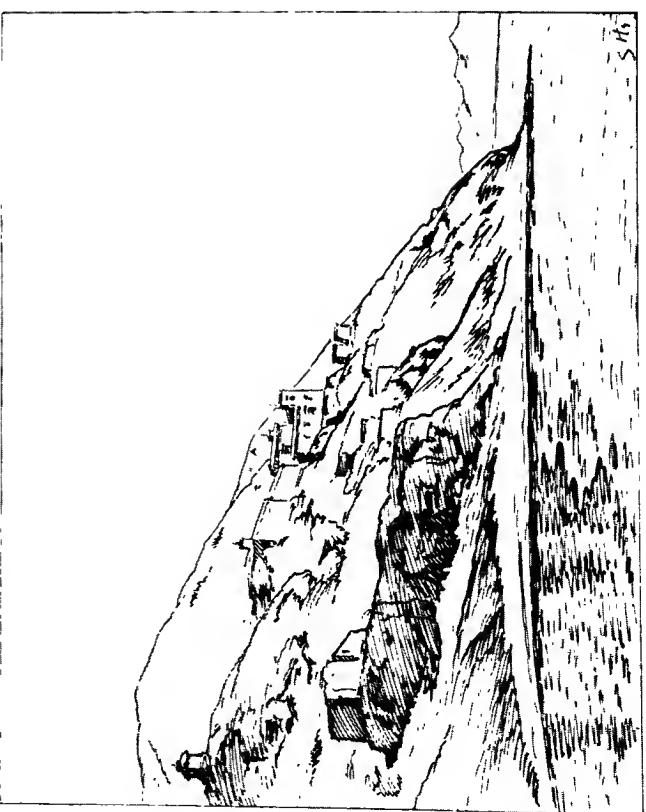
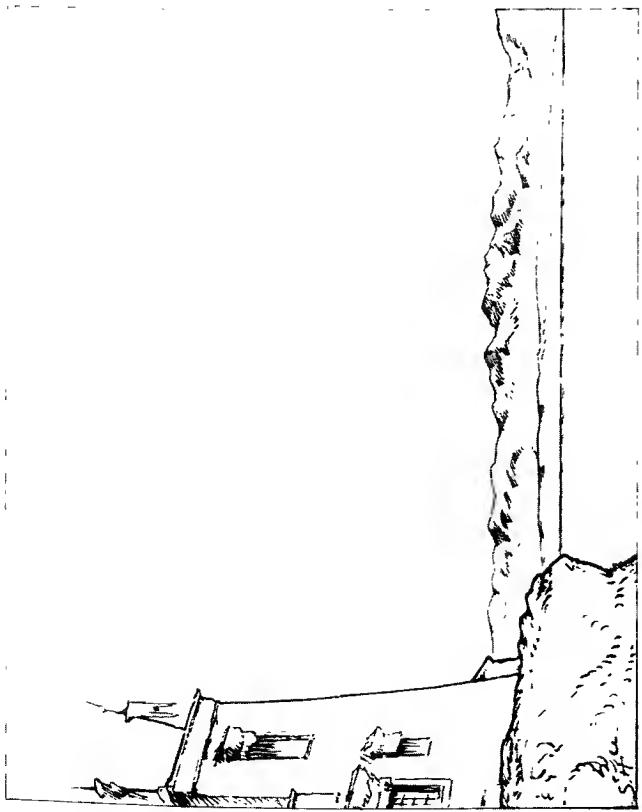
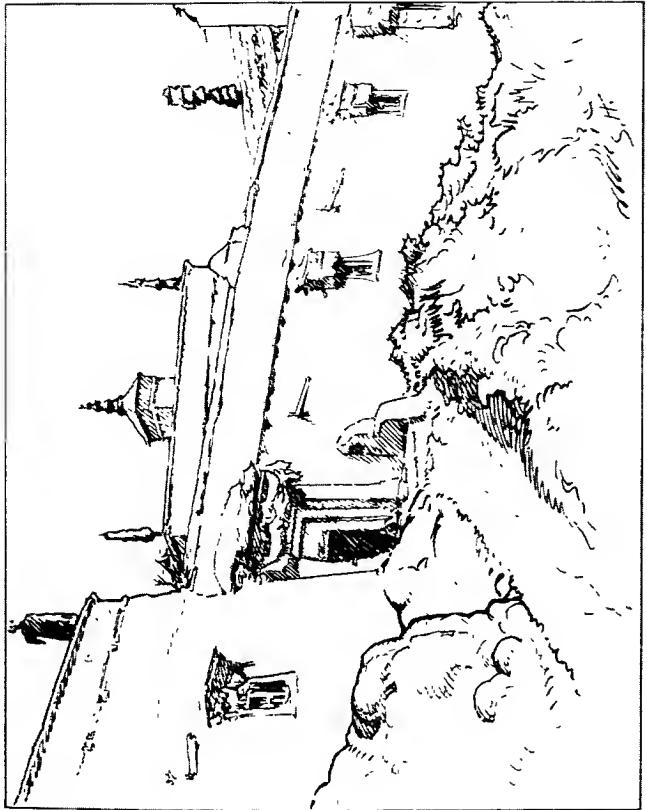
Gosul-gompa is situated on the east side of the neck, between the two lakes and near its narrowest point. The right corner of the second stone step below the wooden threshold at the principal entrance of this *gompa* was, on August 8th, 37.40 m. above the surface of the lake. The slope of the hills, of gravel and shingle, is rather steep and no terraces are visible. It is impossible to draw any conclusions from what the Lamas tell you about the water-stand. The belt of dead algæ, to which the water-line was said to have reached in 1906, was 2.25 m. from the shore of 1907, which would mean a fall of 4 or 5 centimeters. About 1903 or 1904 no lagoons at all existed along the shore. A watermark 0.57 m. above the lake was said to be only a few years old. In 1895 the water should have reached the foot of a block, which, however, was 3.15 m. above the lake and 26 m. from the shore! In 1898 water was said to have passed through the channel of the Ganga for the last time. In about 1875 so much water went out through the channel that it was dangerous to cross it on horseback and one had to use the bridge at Chiu-gompa. At the foot of the hill of Gosul there are two grottoes which may have been caved out by the lake. One of them was, at its lowest, 5.75 m. above the lake, the other 6.88 m.; the first was 36.7 m. from the lake, which also gives the open space between the foot of the hills and the water-line.

A little bit south of Gosul-gompa a road follows up a ravine, and, climbing the rounded, fairly steep hills, one reaches the highest point of the neck between the Manasarovar and Rakas-tal, 285 m. above the surface of the sacred lake. From this point the aspect of the two lakes is extremely instructive and indescribably picturesque. A road on the neck, going north and south, seems chiefly to have been in use at a time when the lake was so high as not to allow a passage at the eastern foot of the hills along the Manasarovar.

The Tibetan guide pointed out the following names: Nakpo-nargo, snowy mountains belonging to the Himalaya and visible at a considerable distance W.S.W.; Tangla, mountain near the lake, S. 60° W.; Kurla (Kur-la, Gurla, Gur-la) or Kurlalayo, S. 17° W., obviously the pass into Purang; Langa-donggang, open plain at the shore of Langak-tso, in S. 20° W.; Resang, a southern valley opening out into this plain.

From the culmination point a little valley takes us down to the eastern shore of Langak-tso, where we cross a series of very well developed and perfectly unmistakable beach lines and walls parallel with the present shoreline. The edge of the highest wall or terrace was now 281 m. from the shore, and 20.7 m. above the surface of the lake.

The way back over the neck to Camp 214 crosses a low threshold, only 58 m. over Manasarovar, this probably being the lowest point on the neck, except the channel. On the eastern side of the little pass is a curious depression between the hills, which has once been a bay of the Manasarovar, but is now filled with a sterile swamp on clay ground impregnated with salt. In its middle are open pools of salt



Views of Gompa on the Western
Shore of the Manasarovar Lake.



water. At some places fresh water springs appear round the swamp. This place is called Putse.

On the north, west and south this depression is bounded by hills. From the Manasarovar it is separated by the ordinary wall of gravel and sand, which, on August 16th, was 6.9 m. above the lake. The distance between the edge of the lake and the nearest shore of the salt swamp was now 406 m., and the surface of the swamp stood 2.35 m. lower than that of the Manasarovar. At the interior or western side of the gravel wall some perfectly clear fresh-water springs came out forming small water courses going to the swamp. The springs had a temperature of 3.4° C. or some 8° colder than the lake and 6° colder than the salt pools. The lake water pierces the filter of the gravel and sand of the wall, but just below the horizon where these springs come out there is a layer of clay which is impermeable. In spite of the fact that the neck between the lake and the depression is so much as 400 m. broad, the water communicates underground through it from east to west. The consistence of the hills and the ground being clay makes it impossible for the water to continue to the Rakas-tal. It evaporates in the depression and only salt and gypsum are left, the latter forming white tables and cubes and making the outlines of the pools very irregular. If the whole neck between the Manasarovar and Rakas-tal were permeable, the water could as easily constantly pour underground from the eastern lake to the western. How far this takes place along one or several lines across the neck I cannot say. At Putse, at any rate, there is no such communication. Putse is rather what the Germans call a *»Salzpfanne«*, and a formation belonging to the same sort as the Kara-bughas of the Caspian. As to the possibility of the water crossing the whole neck this would probably be possible only at one or two places, for most of the neck consists of solid rock. Even when such is not visible it may be hidden by detritus. At the point where the hills rise only 58 m. above the Manasarovar there does not seem to exist any hard rock. The fragments on this part of the neck were graywacke, calcedon and gneiss-granite.

In 1907, the surface of the Manasarovar was only a few inches above the impermeable clay layer. Therefore the springs were not abundant. But when the lake is rising as in 1909 and 1910, the springs must be much more abundant and the pools of the depression larger. If the lake falls below its stand in 1907, the salt pools may perhaps be completely cut off, though, curiously enough, the most abundant springs were not visible near the gravel wall, but at the south-western edge of the depression. The question whether the neck between the two lakes allows water to pass underground or not, does not, however play any important part, for even if such a communication takes place it does not interfere with the functions of the channel.

At Camp 214 there are two beach lines in the hills, the higher being 20.1 m., the lower 8.1 m. above the surface of the lake, on August 16th.

From Camp 214 to Chiu-gompa the solid rock stands steep along the shore, only seldom interrupted by detritus. Higher up, the hills are rounded as usual,

covered with patches of vegetation. At the foot of the rocks there is a road, and it is not necessary to leave the very shore line even once between Chiu and Tugu. This may be otherwise now, after the last few years' rise of the lake. Muddy lagoons surrounded with treacherous ground follow the shore as before. Inside the lagoons the gravel wall continues, sometimes less developed than usual. At one place it was 3.95 m. high above the lake. The rocks dip as a rule to the south and S.W. Round Camp 214 sandstone and conglomerate predominate. Some distance farther north the sandstone stands in 32° S. 20° W. Still farther north limestone appears in 48° S. 20° W. Then follows schist and a rock resembling breccia in the same dip and fall as before. A vein of quartz further north had 44° S. There again limestone in 35° S. 10° W., and farther on the same in 54° S. A red promontory not far south of the bay of Chiu consists of quartzite in 54° S. 40° W. Amongst the detritus at the foot of this promontory appeared also limestone and quartzite. Finally sandstone appeared again.

Chiu-gompa stands on a little rock at the northern bank of the channel. This rock consists of quartz situated 26° N. 70° E. and 19° S. 60° E. The north-western saddle of the rock consists of crystalline limestone, standing vertical and stretching S. 60° E. to N. 60° W. Near the bridge a fine, hard conglomerate lies nearly horizontally, forming flakes, tables and terraces. At some places great blocks of the conglomerate have fallen down and make it rather difficult to pass at the foot along these hills. A short distance below the bridge the conglomerate comes to an end at the northern bank and no more solid rocks appear on the way to the Rakastal along the channel. There are only rolling, low hills, though the fluviatile terraces of the channel are still visible and well developed some distance down to the west. At the left or southern side of the channel the conglomerate continues some distance farther down, projecting small, low promontories towards the channel.

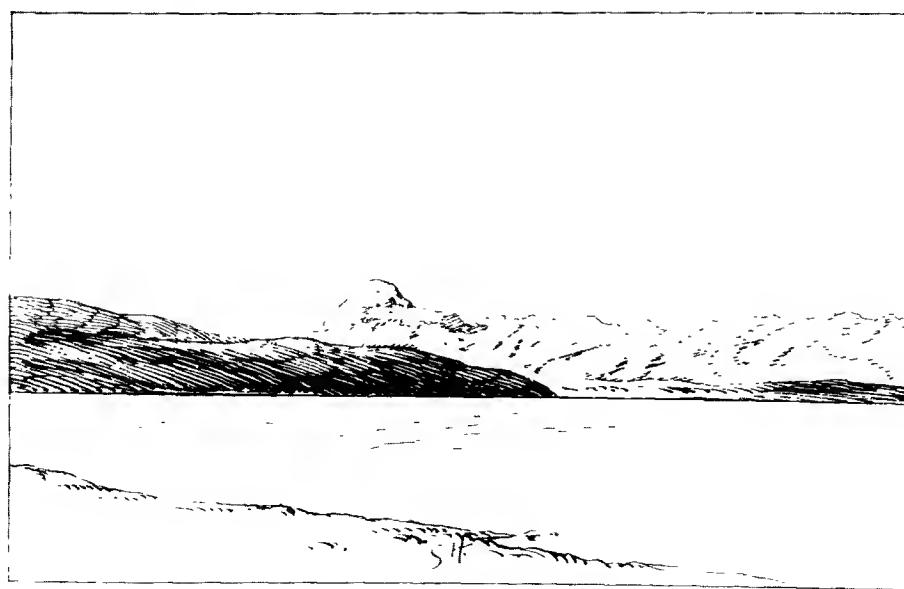
At the first view of the springs below the rock of Chiu one sees that they have nothing whatever to do with the lake, for they are situated about 1 m. above its surface. Between this place and the bridge some hot springs appear from below the conglomerate on the northern bank, and some others seem to come up in the bottom of the channel, which is here filled with stagnant pools very rich in vegetation of algæ. These pools or basins are largest a little below the bridge. Only at narrow places between different pools one can see a very slow current. The water-course continues, however, some distance down the channel. During the winter, when this water freezes and the springs continually pour down water, the channel appears to be quite a big, frozen water-course, although all this water comes from springs and not at all from the Manasarovar. This may have changed during very recent years, when the effluent from the Manasarovar may have continued to flow even during a part of the winter and thus filled the channel with ice formed of Manasarovar water. Ryder says in 1904, that every summer, from June to September, some water streamed through the channel. If that be true the effluent had subsided



THE GURLA-MANDATA FROM CAMP 218, SOUTHERN SHORE OF MANASAROVAR.



GURLA-MANDATA FROM CAMP 228, WESTERN SHORE OF RAKAS-TAL.



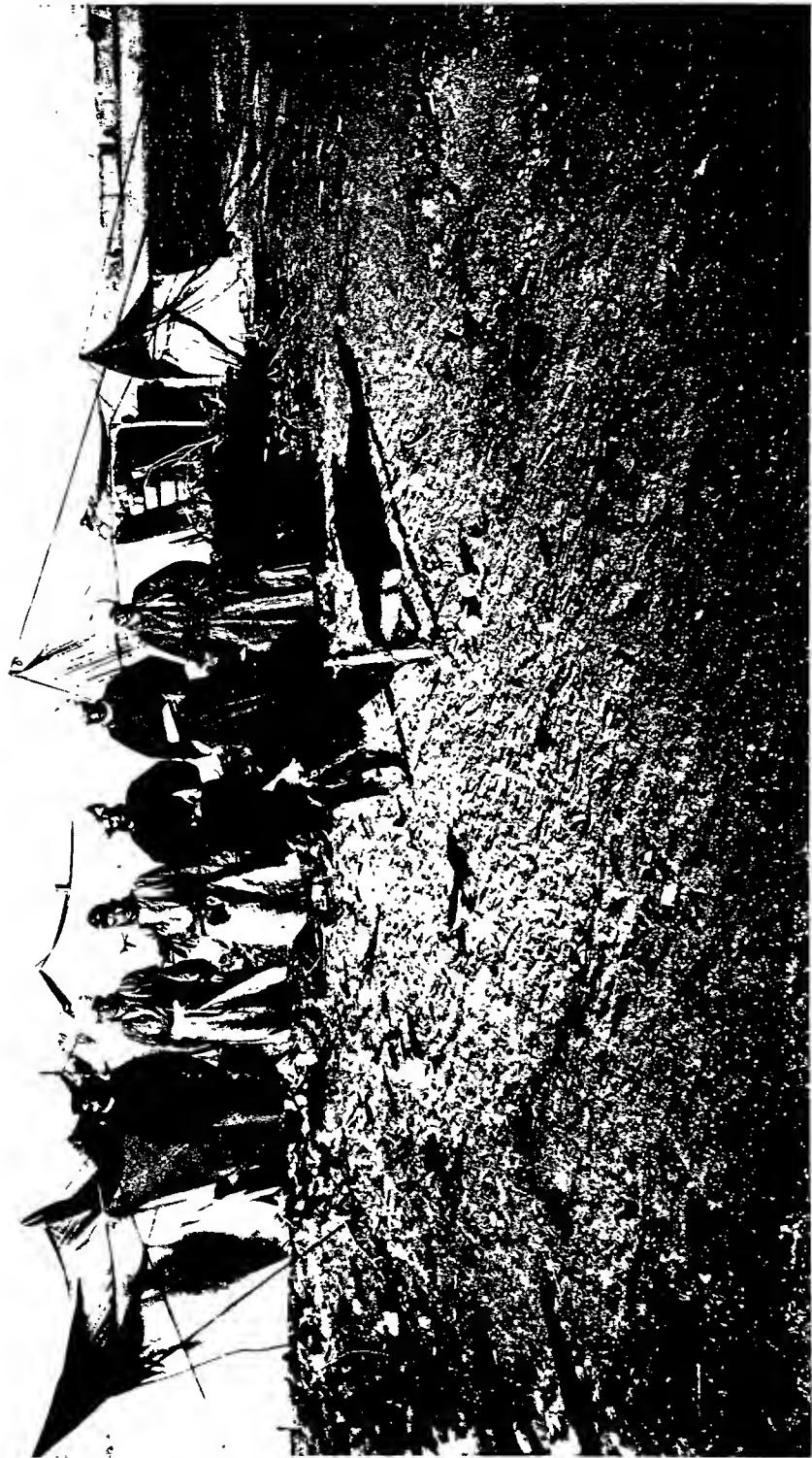
THE KAILAS FROM CAMP 218.



VOL. II.



LOOKING N. FROM GAKTOK.



LADAKHI MERCHANTS AT GARTOK.

from 1904 to 1907. On the block pillars between which the wooden bridge is laid, there was, in 1907, a very distinct water-mark 47 centimeters above the surface of the spring-water pools. A Lama who had passed 6 years in the *gompa* asserted that in 1903 the effluent had reached so far, a piece of information which was obviously wrong. The bridge is old and the water-mark may date from 1846 and 1848 when the Stracheys found a strong current in the channel.

On August 24th and 25th, 1907, I surveyed the channel between the Manasarovar and Rakas-tal, using exactly the same method as in 1901 through the desert of Lop, although the distance there was more than eight times as long.¹ As the difference of the altitude between the surfaces of the two lakes will change from year to year and probably from one season to another — especially when there is no outflow from the Manasarovar, I think it would be superfluous to record here all the readings backwards and forwards from theodolite to staff. It will be sufficient to give merely the result of the survey. I used Hildebrand's »Traveller's Theodolite« and had a 2 m. staff, divided into meters, decimeters and centimeters, black and red. As the ground, both in the bed of the channel and at its sides, is rather soft, consisting of sand and fine gravel with some grass vegetation, the staff was put each time on an iron plate to prevent it from sinking into the ground when turned round 180°.

The distance between staff and theodolite was as a rule 50 m., measured with a tape, sometimes more or less, depending on the configuration of the ground. There are 104 stations in all and 208 readings. The result of all these readings showed that the Rakas-tal then was 13.45 m., or 44.119 feet below the surface of the Manasarovar.

The measured line runs chiefly in the very bed of the channel, only sometimes at its sides. The line, as measured with the tape, is 9,366 m. long. But this line is not straight, especially at its beginning and end it meanders like the channel itself. The neck between the lakes will here be about 9 k.m. broad or a little more than 5½ miles, so Ryder has made it too narrow, estimating its breadth at 3 miles. But Ryder is very near the truth when he estimates the difference in height at 50 feet. In 1909, 1910 and 1911 when the Manasarovar was about two meters higher than in 1907, Ryder's 50 feet were probably perfectly correct.

In the channel, station N:o 4, just at the foot of Chiu-gompa, was the highest level above the surface of the Manasarovar, namely 2.263 m. Thus the lake had to rise 2.263 m. before any water could flow over into the Rakas-tal. Ryder says, in 1904, that a rise of about 2 feet in the level of the lake would cause water to flow down the channel, which proves that in 1904 the lake was considerably higher than in 1907. Remembering that in 1909 to 1911, an effluent really went out we get a direct value of the considerable oscillations of the level even within a very few years. Only between stations N:o 23 and 24 did I cross a point which was at the same level

¹ Scientific Results of a journey in Central Asia 1899—1902, Vol. II. p. 314 et seq.

as the Manasarovar, and from which, to the W.N.W., the channel slopes down to the Rakas-tal.

So far as to station N:o 94 the channel contained brackish water from the springs. It was, however, only a very narrow water-course, which at many places could be jumped over. Only at such narrow places is the current visible. At other places it widens out to basins where no current is seen at all.

The bed is bounded by very well developed fluviatile terraces 2 or 2.5 m. high, and becoming lower, 1 m. and less, in the direction of Rakas-tal. They consist of horizontally deposited gray clay. The dry portions of the bed are lightly incrusted with salt. The fresh condition of the terraces, and their sharp edges prove that it cannot be long ago since water flowed down the whole way. Only at Chugompa and downwards, a little beyond the bridge, is the channel narrow and pierces the conglomerate. In the direction to the Rakas-tal the country becomes more and more open.



THE VALLEY BETWEEN
TSEUL-LA-CHU-NIA AND
SING-BUK, LOOKING
SOUTH. SEPT. 9, 1907

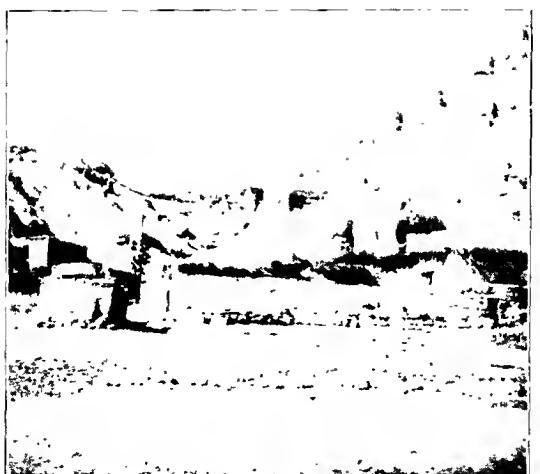


LOOKING DOWN THE SAME
VALLEY IN THE DIRECTION
OF THE UPPERMOST INDUS.

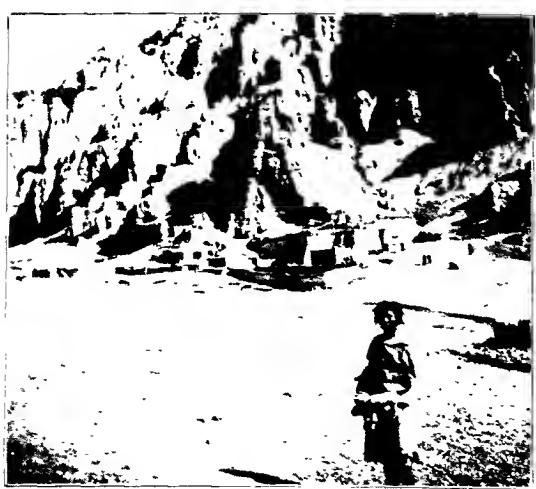
THE RABGNALING VALLEY, A TRIBUTARY TO THE UPPER SATLEJ, LOOKING S.S.W.



THE BRIDGE OF KYUNGUNG.



DABA-GOMPA.



DABA-GOMPA.

CHAPTER XXIII.

THE DEPTH OF THE MANASAROVAR.

In the course of time the outlines of the Manasarovar, as well as those of the Rakas-tal, have, on various maps, been represented in very different ways, all from the famous Lama map of d'Anville and down to the maps of our days. The Manasarovar has a very regular outline, is almost round, or a little oblong, from north to south, whereas the Rakas-tal is more irregular in form. Ryder's map of the lakes is a very good piece of work, though he had no opportunity to visit the southern shores. So far as my own map is concerned the survey of the Rakas-tal, which I carried out by land, following all the irregularities of the shore-line, is better than that of the Manasarovar where the eastern, southern and western shores were mapped from the boat, and only the northern shore by land. A survey from a boat is of course more liable to errors on account of currents and winds.

Even the first sight of a map of the Manasarovar, and still more of the country itself would make you suspect that the greatest depths were to be found in the southern part of the lake. For here the enormous Gurla-mandata is much nearer than the comparatively lower mountains in the north. And as we have seen, the fans from Gurla slope steadily down to the very shore and dip into the lake, whereas a comparatively extensive plain is situated between the foot of the Pundi mountain and the northern shore.

My soundings proved that the Manasarovar is probably the deepest lake of Tibet; at any rate it leaves far behind all other lakes I have sounded during earlier expeditions. In 1900 I had found 48.67m. in a fresh-water lake in the eastern part of the Tibetan plateau-land, and in 1901 I had got 47.50m. in the Panggong-tso.¹ But the Manasarovar had a depth of no less than 81.8m. and the deepest part is in the southern half of the lake and nearer the western than the eastern shore. In vain I waited for an opportunity to sound the Langak-tso or Rakas-tal, but was prevented by continuous hard wind. If it be true, as the Tibetans assert,

¹ Scientific Results etc. Vol. III, p. 130, and Vol. IV, p. 334. — Central Asia and Tibet. Vol. I, p. 554, and Vol. II p. 578.

that the western lake freezes one month earlier than the eastern, then the former is very likely shallower than the latter. More difficult it would be to understand why the Rakas-tal should break up about 15 days earlier than the Manasarovar, which is also said to be the case. If it be true it may depend upon some local wind, which is not unlikely; during my stay at the lakes at least the Rakas-tal was usually exposed to very strong winds at the same time as the neighbouring lake enjoyed calm weather. And it may be the same in the spring.

As regards the soundings only a few words are necessary. The accompanying map (of my Atlas) will show how they are distributed over the lake. On the line from Camp 212 to a point a little south of Camp 213 we find two maxima, 65m. in the eastern half, and 81.8 in the western. Between the two is a minimum of 55.5m opposite the mouth of the Tage-tsangpo, which, during an earlier epoch, may have carried down so much solid stuff into the lake that the distances between the isobaths have gradually grown greater, and the lake shallower in this part. No such convexities of the isobaths can be noticed outside of the mouth of the Samo-tsangpo. Only outside the Gyuma-chu is the lake comparatively shallow. The fact that the deposits of Tage-tsangpo influence the isobaths almost to the very middle of the lake affords us a new proof of the correctness of the Chinese view, namely, that the Tage-tsangpo is the source of the Satlej, and not, for instance, the Samo-tsangpo or any other river falling into the Manasarovar.

Along this line 28 soundings were made at fairly equal distances; the average depth being 59.8m.

On the line between Camp 212 and 214 the same arrangement may be noticed, although less developed. For the maxima are here 60.3 and 57.5m., and the minimum between them 55.2m. Along this line 20 soundings were made, the average depth being 52.7m.

On the line between Camp 212 and Chiu-gompa there are again two clearly developed maxima, 55.4 and 49.8m., with a minimum of 33m. between them. The Gyuma-chu cannot be responsible for the course of the isobaths on this line, for the minimum is far east of the mouth of that river. There are 19 soundings and the average depth is 44.4m. Comparing the three lines we get a value of the rate by which the lake becomes shallower from south to north, namely, 59.8m., 52.7m., and 44.4m.

As compared with these principal lines of soundings, the others are less important and chiefly serve the purpose of completing the isobathic map of the lake. The two S.E.—N.W. lines in the south-western part of the lake cross not far from the deepest depression and have the maxima of 77 and 76m. resp. The two short lines from the southern shore, ending at depths of 63.5 and 56.2 resp. prove that the southernmost part of the lake goes down fairly steeply to the deepest depression, which *a priori* was likely from the appearance of the Gurla fans. The two lines directed southwards from Camp 220 and 222 at the northern shore clearly show

the comparative shallowness of the lake in this part, where the plain south of Pundi very slowly continues under the surface of the lake. And still the depth at the end point of the eastern one of these two lines, or 47m., is nearly the same as the absolute maximum I found in Panggong-tso, a lake, that one would have expected to be much deeper as situated like a grave between gigantic and very steep mountains.

The two following tables may give an idea of the rate at which the temperature of the water at the bottom sinks, together with the depth:

Number of sounding from shore at Camp 220.	Depth in metres.	Temperature at bottom.	Temperature at surface.	Temperature of air.
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I	3.8	13.4°	13.2°	13.3°
II	6.0	12.5	13.1	13.0
III	12.3	11.8	13.1	13.4
IV	33.5	8.7	13.1	14.3
V	38.6	8.2	13.2	13.7
VI	41.5	8.0	13.1	14.4
VII	47.0	7.8	13.1	12.5

Number of sounding from shore at Camp 222.	Depth in metres.	Temperature at bottom.	Temperature at surface.	Temperature of air.
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I	7.0	12.28°	12.2°	11.3°
II	17.1	10.80	12.2	12.0
III	23.0	10.70	12.1	12.5
IV	26.9	10.15	12.1	12.6
V	28.0	10.10	12.1	12.9
VI	29.9	9.95	11.6	13.0
VII	35.0	9.90	11.0	12.4
VIII	39.6	9.28	11.2	13.6
IX	41.4	9.22	11.2	13.3

CHAPTER XXIV.

SURROUNDINGS OF THE RAKAS-TAL.

Following the shore of the Rakas-tal southwards from Camp 223 to Camp 225 and 226 one finds, to begin with, comparatively low hills in the east and a very narrow, gravelly slope between their foot and the shore. There are no lagoons at all, unless the narrow strips of water should be regarded as such, which at two or three places have been swept over the low beach wall by the waves. At Camp 225 the rock *in situ* is limestone and quartz in $49^{\circ}\text{N}.75^{\circ}\text{E}$. A little farther south we have sandstone in $41^{\circ}\text{S}.25^{\circ}\text{E}$. and sandy slate in $60^{\circ}\text{S}.40^{\circ}\text{E}$. Still farther south we find phyllitic schist in $37^{\circ}\text{N}.60^{\circ}\text{W}$., at the place where the narrow passage of the lake opens out to the large southern basin. Here the rock falls rather steeply to the lake. The rocks are much folded but as a rule the fall is towards S.E.

The direction, which so far has been S.S.E., becomes now S.E. fairly straight, and the open shore at the foot of the hills is narrow as before. Above the naked rock wall the hills are rounded as at the eastern side of the neck. After a while the rocks come to an end and the shore plain gets wider, corresponding to the depression of Putse at the eastern side. The shore forms a very regular, lightly curved line with a low sand wall. The ground is composed of sand and some gravel. Walking along this shore it is impossible to become aware of the three islands in the southern part of the lake; they seem to be parts of the mountains on the southern and western shores. This explains why different travellers have given different accounts of them. From the hills above Gosul-gompa they are very well seen.

Near Camp 226 solid rock is again found, namely, harzburgit, diabas and a quartzitic mass, all in 73°S . This was, so far as my excursions allowed me to observe, the only place on the southern half of the neck, where rock appeared *in situ*, which does not of course exclude the existence of a solid rock-skeleton in the interior of the neck, though hidden by detritus.

The southern shore of the Rakas-tal is very fatiguing, for the rocks reach the immediate neighbourhood of the lake and as a rule one has to ride or walk amongst the gravel at their foot. The first sharp promontory, pointing to the N.W., consists

of harzburgit in $24^{\circ}N.40^{\circ}E.$, but amongst the detritus one finds granites, gneiss, crystalline schist and other specimens generally rounded by the waves. At the western side of the promontory the harzburgit dips $76^{\circ}E.$, and still farther west $47^{\circ}E.$ A narrow valley opens to the bay west of the promontory and here is a road from Purang; a caravan of sheep, just passing here, came from Purang and was on its way to Lumaring-tso and Kerki in the interior of Western Tibet. The valley was called So-longyo, though this name is doubtful.

Then follow some small bays and promontories and finally a large, not very deep bay, before Camp 227 is reached at the very point of a sharp, rocky peninsula. The rock is the same harzburgit as before, now in $41^{\circ}N.2^{\circ}E.$ N.N.E. and not far from the shore is a little rocky island, Lache-to. It takes only 25 minutes to walk round the island along its shore. It consists of solid rock rising steeply from comparatively deep water, or 34.5m., halfway between the island and Camp 227. The rock of the island consists of the same harzburgit in $38^{\circ}N.40^{\circ}E.$ At the foot of the rock are heaps of detritus and sometimes more or less well developed terraces. The north-eastern part of the island forms an open plateau, and here, amongst sand, gravel and vegetation, the wild geese breed in spring and early summer as could be seen from thousands of eggs. The people of Parka plunder the nests of the wild geese every spring, and reach the island on the ice, which indicates that at least this more protected part of the lake remains frozen rather long, say six months. A little ring wall also proves that the island is occasionally visited.

The section of the shore from Camp 227 to 228 is also very irregular, for the mountains of the southern shore send forth a series of ramifications and spurs forming promontories and peninsulas. In each bay between them a valley or ravine is formed, sometimes with terraces, seldom with a minimal brook, which disappears into the gravel before it reaches the shore. These little valleys seem to be very short, and there is hardly room for any considerable length, as the great Purang valley is near at hand on the southern side of the ridge.

Following this shore one has a feeling of being in a labyrinth between water and land. The perspective is very picturesque and changes every moment. One has a series of promontories westwards and understands that each of them is situated between two bays. A terrace follows the foot of the rocks; it is exactly 10m. high (August 30th), and at Camp 227 it was 48m. from the shore; sometimes it is interrupted or disturbed. The same harzburgit rocks continue the whole way, in $73^{\circ}N.45^{\circ}E.$, $48^{\circ}N.$, and $40^{\circ}N.70^{\circ}E.$ The two islands are easily visible in the south-western corner of the lake, but one can only seldom make out that they are real islands and not parts of promontories. There may possibly be three of them. The greatest is called Dopserma, though other Tibetans called it Dotser.

One promontory could be cut off in a pass about 100m. above the lake. West of it is a long narrow bay. At the sides of a valley coming out here, per-

perpendicular fluviatile terraces prove that sometimes a good deal of rain water flows down from the southern mountains. At the time of my visit it contained only a little brook from a spring, surrounded by good grass. West of this valley is another pass, higher than the first and with a cairn on its top; it cuts off one or two promontories.

At the westernmost corner of the lake two more considerable valleys open out into a little sandy plain, which probably has been covered with water at a period when the Satlej emerged from the north-western corner of the Rakas-tal. Black stripes of dead algae in the sand show how the lake has gradually subsided. The little plain is crossed by a water-course, 3m. deep and from 10 to 20m. broad, now only containing stagnant pools of water.

From camp 228 the western shore turns off north-eastwards. A comparatively large peninsula is cut off; it has a perfectly isolated hill which has probably at one time been an island. The shore plain is broader than at the eastern side, the ground is sand and clay with some grass and steppe-vegetation. A wall of fine hard gravel crosses a part of the plain and points to the N.E., just as another formation of the same kind situated at the western side of the entrance to the narrow part of the lake. The only difference is that the former is now situated on dry land, though it must have been formed in water, by winds and waves. The long narrow gravel pier which projects from the shore is situated N.E. of a sharp mountain corner, and therefore has no doubt been formed by the sand and fine gravel which, is swept along the foot of the mountains out into the lake by the prevailing S.W. wind. This pier is broader at its base, and ends with a hook turned northwards.

At this place the rocks fall steeply, almost perpendicularly, towards the lake. First we come across mica-quartzite in $54^{\circ}\text{S}.20^{\circ}\text{W}$. and a little farther north limestone in $57^{\circ}\text{S}.35^{\circ}\text{W}$. and $58^{\circ}\text{S}.10^{\circ}\text{W}$. There is no shore plain here; the gravel scree at the foot of the rocks falls steep and narrow to the lake. The mountains are red, in sharp contrast to the green lake and blue sky.

Beyond the pier the shore plain becomes broader again. The shore line runs fairly straight northwards without capes and bays. The ground is covered with wind-blown sand. At some places small flat blocks, 1 or 2dm. in diameter, lie upon pedestals of sand like glacier-tables, this being the work of the hard, almost constant wind. Around Camp 224 much sand has been heaped, even forming dunes, which, at a cape north of Camp 224, fall steep into the lake; from their crests a rain of sand is blown out into the lake.

On two lines between Camps 223, 224 and 225 I could sound the depth, and found at the northern line a maximum of 16.6, and on the southern 28.3, showing that the lake becomes deeper from north to south, like the Manasarovar, and as could be expected from its configuration and its surroundings.

At the northern section of the western shore some springs rise from the ground, which at certain patches is swampy and treacherous. Crossing the depre-

sion in the prolongation of the north-western corner of the lake we recognise the place where the Satlej formerly used to flow out of the Rakas-tal. It is not like a river bed. The ground is dry clay, and no fluviatile terraces or river banks are visible. Some springs rising in the depression run into the lake. But all this is in perfect agreement with the circumstances which must have prevailed when the Satlej left the Rakas-tal. For the low clay ground was then inundated at a considerable distance westwards, and only at some distance further N.W. could one expect to find any traces of an old bed.

On September 6th, 1907, I made an excursion to the dry bed of the Satlej which I reached at a point some 7km. N.W. of the one where I had first crossed it. About 1km. S.E. of this western point some comparatively large pools of stagnant water filled a part of the bed. They are formed by springs and probably brackish as they did not contain any vegetation. Here the bed is sharply bounded by old river terraces, though very much deformed since water flowed through. One could see that the bed had been partly filled with clay and sand, swept down by temporary water-courses after heavy rains, and in these alluvia secondary terraces and furrows had been modelled by the wind. The vegetation and innumerable rabbit-burrows had also destroyed the fresh appearance of the bed. Such changes as these do not, however, require a long time, and the old river bed is always very easy to recognise as such. A little farther N.W. the rounded sand terraces are 4 and 5m. above the bottom of the bed.

This second point in the bed must be its highest, or a few metres above the Rakas-tal. Continuing north-westwards in the bed one comes to some large fresh-water pools. From the last of them a little brook flows north-westwards, so here at any rate the culminating point of the bed has been passed and the definite regular slope to the Indian ocean has begun. The watercourse enters a large pool filling the whole bed. A little lower down where the bed enters a real valley, Laling-tak, bounded by rocks on both sides, a spring rises from the ground and forms a little brook, surrounded by good grass and streams down the valley. At Dölchu-gompa one is already 72m. below the surface of the Rakas-tal. The question when the Rakas-tal last sent an emissary through the bed cannot be answered with any degree of certainty. And it is of course impossible to know whether this will be the case again. Remembering the general desiccation which the whole of Tibet is undergoing, it seems unlikely that the Rakas-tal will rise above the highest threshold in the bed. But we have seen that the Manasarovar has been able to send, in 1909 to 1911, an effluent through the bed of Nganga or Ganga, and the possibility is not excluded that this might be the case with the Rakas-tal as well, provided a sufficiently wet climatic period entered during a few years.

At the entrance of the valley, Laling-tak, the rocks are of limestone and lime-spar in 9°N . and in $12^{\circ}\text{N} . 73^{\circ}\text{W}$.

Between the Kailas and Rakas-tal there is a much more extensive plain than the one north of the Manasarovar. The ground consists of sand and gravel, covered with sparse steppe-vegetation and bushes, and, nearest the lake, very good grass. On this plain Parka is situated on the *tasam* or high-way. The river which falls out in the middle of the northern shore of the lake is formed from the brooks of the valleys on both sides of the Kailas; one of its branches passes Parka. When I crossed this river, on July 28th, 1908, it flowed in two branches, one having only 2 or 3 cub.m., the other 15.

CHAPTER XXV.

THE OSCILLATIONS IN THE WATER-LEVEL OF THE LAKES.

In the preceding chapters I have tried to give a *resume* of the history of exploration in the region of the Manasarovar and the Rakas-tal, and I have especially tried to bring together as many records as possible about the connection between the lakes and between the western lake and the Satlej. In the latter respect the result has not been encouraging. For, as a rule, the earlier records are either unreliable, or, even if they seem to be reliable as regards facts, they do not allow us to fix the date of the observations. The only exception from this is the Lama survey. Then follows a century with uncertain information, and only with MOOR-CROFT do we enter upon solid ground.

The problem is, however, one of very great interest. In itself it is not of great importance whether water at a certain period flowed out of the lakes or not. Only on account of the bright light it spreads over the oscillations in the last, or present, climatic period, does the question become important. But even during the last century the records are very few, and at any rate insufficient to make it possible to follow the periodicity of the curve. This should not be surprising, for it may even be difficult to arrive at reliable conclusions when comparing old maps and descriptions of lakes and rivers in Europe with the present state of things. How much more difficult must it then be to study the oscillations in a couple of Tibetan lakes, which only a hundred years ago were visited by the first scientifically trained European, and since his time have been seen by only a very few reliable visitors.

And still these two lakes present us with a most excellent and sensitive instrument for measuring the changes in the climate, especially the precipitation. The instrument is there, but its records have only in a very few cases been read and understood. With great patience and trouble the glacial geologists have tried to interpret the silent story told by the old front moraines of Himalayan glaciers to find out the advance and retreat of the ice streams. The general result at which they have arrived may be expressed in the following words by GUY E. PILGRIM:

It is beyond dispute that the Himalayan glaciers came down to a much lower level in the past than they do to-day. Ancient moraines and evidences of glacial action have been noticed at elevations varying from 5,000 feet to 8,000 feet by Hooker, Macmahon, Godwin Austen, Blanford and others. The theory, once held, that the Himalayas then stood at a greater elevation than is the case to-day, may be at once dismissed, and we can safely admit that much lower temperatures prevailed in the Himalayan region at that period. It does not, however, follow that the temperature of the Indian peninsular area was appreciably lowered thereby.¹

The glaciers of Himalaya and Kara-korum begin in our days to attract more and more attention. Some of the last visitors to the Kara-korum glaciers have been able, by comparing their own maps with those of GODWIN AUSTEN and others, to tell whether certain snouts have advanced or retreated. Such records will be more reliable and numerous in future. And there will be a special study of the influence of the monsoon rains upon the movements of the glaciers. We do not need to go far back in time to become completely lost as regards information in these matters. An augmented precipitation over the mountains will cause the snows to accumulate and the glaciers to become more active and *vice versa*. But the glacier movement is always delayed. The rise and fall of the levels of the Manasarovar and the Rakas-tal would afford a much more delicate, reliable and convenient instrument for reading the hydrographical influence of the precipitation. And if such records were carried out for any considerable length of time, say 100 years, it would be possible to tell in which direction the climatic changes proceed and with what speed, during the present period. One should get the values of the periodicity, at least for the second and third order; for the highest order a much longer time would be necessary.

But such regular records are, and will probably remain nothing but pious *desiderata*, and at the present moment all we can do is to collect as much material of observation as possible, and to try and draw out some general conclusions from it.

The Tibetan plateau-land is very rich in lakes. As mean altitude for 37 lakes in Western Tibet I found 4,837m., and for 58 lakes in Eastern Tibet 4,811m., so that the western lakes proved on an average to be 26m. higher. Comparing, for instance, DEASY's six highest lakes in Western Tibet with my six highest lakes in Eastern Tibet, I obtained means of 5,056m. and 5,001m., proving that Deasy's lakes were on an average 55m. higher. But, as a rule, there are extremely small differences in height between different lakes on the plateau-land. Only when we approach the boundaries of the plateau-land, the absolute altitude of the lakes becomes less, the Manasarovar being at 4,602, Panggong-tso at 4,317, Jamdok-tso at 4,210, Achik-köl at 4,250, and the Upper Kum-köl at 3,882m.

¹ »On the changes of climate in India during the Postglacial portion of the Pleistocene»; in »Die Veränderungen des Klimas seit dem Maximum der letzten Eiszeit», 11 Internat. Geologenkongr. Stockholm 1910, p. 441.

As the real plateau-lakes are all situated at nearly the same height above the sea, they are in the same way exposed to changes of climate. And still we find lakes in all possible states of development. Regarding the fresh-water lakes only it would be in many cases difficult to tell whether they are stationary or sinking, for there may be no terraces at all beside them. Around others, more or less salt, there are low beach-lines or strand-terraces; and yet others, as the Lakor-tso, which are extremely salt, have beach-lines up to 133m. above the present level. The fresh-water lakes are always deeper than the salt lakes, which are sometimes extremely shallow, for instance the Ngangtse-tso. In some lakes we find only little pools of water surviving amid an expanse of nothing but salt and gypsum; while others are temporary, and others again completely dried up.

The absolute height does not seem to have anything to do with the extent to which the desiccation has proceeded. But the geographical position seems to play an important part. For the desiccation advances more rapidly in the south than in the north, and more rapidly in the west than in the east. It is difficult to account for this, unless it depends upon the fact that the monsoon loses its influence as it proceeds towards the interior of the highland plateau. But to this it may be objected that innumerable lakes in the interior of Asia are diminishing in spite of their being far away from the influence of the monsoon.¹

Hardly any European traveller has crossed or visited a portion of the Tibetan plateau without noticing the desiccation of the salt-lakes, for no observation of physical geography is easier to make. The concentric, often very well preserved terraces and beach-lines prove that the lake has been much larger in former times. In times past the desiccation has obviously proceeded gradually towards the complete extinction of the lakes, as this goal has been reached by many of them, as can be easily seen in some depressions where nothing but the old terraces are left. As to the rate and speed of this desiccation we know nothing. And still less are we able to know whether this desiccation is going to continue in the future. The several beach-lines round Lakor-tso only tell us of a depression of the desiccation curve, and there is nothing at all against the plausibility of a future rise of this curve, when the old beach-lines may be reached by the level of the lake one after another.

The only thing we may be pretty sure of is, that the desiccation has not proceeded with constant regularity. For within the great period of desiccation there have been shorter periods, and within them still shorter, with a length of only a few years. Here the history of the Manasarovar comes to our assistance. What is going on there under our direct control may certainly be said to be going on in every lake on the Tibetan plateau-land. And from this point of view the oscillations in the Manasarovar may serve us as a key for solving the problem, at least partially.

¹ Compare: »Hypsometry and relief of the Tibetan Plateau«, and »Lacustrine problems. Desiccation etc.« Scientific Results of a Journey in Central-Asia 1899—1902. Vol. IV, p. 582 and 595.

Admitting that a general desiccation is taking place all over Tibet, the next question is: why? What is the cause of this desiccation? We observe the facts and see the obvious results, but where is the agency?

In order to find an answer we may examine some of the researches made in another Asiatic country, the situation and configuration of which may allow us to compare it with Tibet, namely, Persia.¹

In Persia the question will have to be put thus: are there any evidences of a former pluvial or lacustrine epoch in Persia, which may be supposed to have taken place at the same time as the glacial period in Northern countries? During my last journey through Persia I became convinced that the depressions, Kavir, in the north-eastern part of the country must once have been filled with salt lakes.

Professor E. BRÜCKNER has compiled a most interesting monograph on the changes of level in the Caspian Sea during historical time, and he gives the great occurrences of change in the following table:

Anno 915—921	+ 8.8 metres
XIIth century	— 4.2
Anno 1306	+ 11.2
Anno 1638	+ 4.9
Anno 1715	+ 0.3

The oscillations of the level of the Caspian run, as Brückner finds, absolutely parallel with the periodicity of precipitation in the regions which drain to that sea. And as he has found that nowadays glaciers and lakes change simultaneously, he has no doubt that the case was the same in Diluvial times. In the interior of the continents where glaciers had no opportunity to form, lakes were formed instead. Thus the area of the Caspian was about twice as great as now, the area of Lake Aral at least thrice, and most of the Kisil-kum and Kara-kum deserts were covered with water.²

In 1903 R. PUMPELLY found old Caspian shore-lines near Baku at heights of 300, 500 and 600 feet. ELLSWORTH HUNTINGTON who travelled in eastern Persia near the Afghan frontier down to Seistan, has discovered some unmistakable proofs of a profuse precipitation during an epoch which is supposed to have been equivalent to the glacial period in higher latitudes. The Quaternary deposits and terraces of Persia seem to be the result of a series of climatic oscillations, and in Seistan Huntington reckons as many as 14 or 15 oscillations between dry and moist periods.

At Seistan and probably elsewhere, a series of lakes appear to have occupied the basin during the Glacial period. At the lake of Kogneh Huntington found river- and lake-terraces showing that fluvial and lacustrine periods have alternated with

¹ I have touched this problem in »Overland to India», Vol. II, p. 208, and »Some physico-geographical indications of Postpluvial climatic changes in Persia», in the work *supra cit.* of the Geological Congress in Stockholm 1910.

² *Klimaschwankungen.* p. 43 et seq.

interfluvial and interlacustrine, and he explained the phenomenon by the help of the climatic theory. Those periods, in his opinion, were simultaneous with the glacial periods. He gives detailed descriptions of terraces in many other places, all proving that the lakes of western Asia in a rather late geographical period were much larger than now. Concerning the Lora-hamun VREDENBURG has arrived at the same conclusion, for he finds that this lake has been three or four times bigger than now and 50 feet deeper. The recent geological history of Persia is characterised thus by Huntington: it begins with an arid climate at the end of the Tertiary era, after which ensued a fluvial period composed of some fifteen fluvial epochs of prolonged rivers and expanded lakes, separated by interfluvial epochs of shortened rivers and diminished lakes. The fluvial epochs increased in frequency and possibly in length and intensity from the beginning up to about the middle, after which they decreased.¹ Huntington believes that the process of desiccation is still going on, and that the last fluvial period includes both the age of Alexander, 300 B.C. and that of ISTAKHRI, 900 A.D., as Alexander could not possibly have been able to carry out his retreat from India had the climatic conditions in his time been the same as now, and as the Caspian had such a high level in Istakhri's time, as is noted from 915 to 921.

BLANFORD had much earlier expressed the opinion that the desert basins of Persia were once filled with water. He says: 'The deposits in the central portions of the desert plains are usually a fine pale-coloured loam, often covered over by shifting sands. These fine deposits may be of lacustrine origin, for it is probable that lakes have once existed in the enclosed plains without outlets, which are now deserts. The surface appears flat, but there is probably in all cases an imperceptible slope towards the middle of the plain.'² Blanford is also aware that such lakes could not possibly have been formed in the interior of Persia, unless the climate had been much moister than it is now.

F. VON RICHTHOFEN criticised Blanford's views, saying that all theories about deposits in basins without outlets, and about the formation of *loess*, are founded upon the supposition of more numerous lakes and richer precipitation formerly, whereas Richthofen on the contrary explains both phenomena by a climate much drier than at present.³

Nor could Dr. EMIL TIETZE accept Blanford's theory, and he could find no argument for the supposition that the Persian basins in a late geological time had been covered by water. The general decline in Persia, within historical time, does not depend on climatic changes. He ascribes the basin deposits to the same sub-aerial causes which have accumulated the *loess* in China.⁴

¹ Explorations in Turkestan, Washington 1905, p. 301.

² Eastern Persia, Vol. II, p. 465.

³ China, Bd I, p. 174.

⁴ Zur Theorie der Entstehung der Salzsteppen. — Jahrbuch der K. K. Geologischen Reichsanstalt, Bd 27 (1877), p. 341 et seq.

On the other hand Captain VAUGHAN makes the following statement: »I made a collection of various marine shells, including oyster-shells, between Chashma-Gauhir and Baba-Khalet at an elevation of 100 or 200 feet above, and within 2 or 3 miles of the Kavir bed.«¹ If these shells were found *in situ*, they offer us a starting point for at least some preliminary acquaintance with the ancient lake at one of its levels. The average height of the southern border of the Great Kavir I found to be 735 m. The lowest point in the interior of the desert was at 685 m. The difference between the border and the centre was thus 50m., and Vaughan's shells should date from an epoch when the lake had depths of 100m.

Along a meridional line across the Kavir from the edge near Jandak and northwards, I found, the absolute heights: 779, 758, 722, 685, 709 and 718m., the line being 110km. long. On a more easterly line, between Turut and Arusun, the difference in altitude in 120km. amounted to 56m. maximum. The depression is clearly shown in both cases, and only a lake can account for the levelness of the desert. All round from the edge of the Kavir, the ground, whether sand, gravel or steppe, begins to rise slowly. The silt and clay, and the perfectly horizontal sheets of solid salt, sodium chloride, can only have been deposited in a lake. Only at Turut did I find a typical *loess* terrace, from the foot of which, at 799m., the detritus fan slopes slowly down to the edge of the Kavir. This *loess* may have been deposited at some period of the later Tertiary when the climate was dry. Then followed the pluvial period corresponding to our ice age.

It would be difficult to explain the absence of lakes in the Kavir and Lut depressions during diluvial times, since it has been proved that the Caspian had such enormous dimensions and the depression of Seistan was filled with water. At the end of the pluvial epoch the Kavir lake began to dwindle. At present the desiccation has proceeded so far, that only after rains in winter a few temporary pools and salt marshes can fight against evaporation for some time.

As to the speed with which the desiccation has proceeded during post-pluvial times it seems impossible to express an opinion with any degree of certainty. Even within historical times it seems difficult to give real proofs of climatic changes. Brückner says: »eine Änderung des Klimas, wie sie seit Schluss der Eiszeit eingetreten sein muss, ist in historischer Zeit noch nicht mit Sicherheit erwiesen und noch wird über die Frage hin und her discutiert; gerade die hydrographischen Phänomene, welche unsere kurz dauernden Schwankungen so trefflich wiederspiegeln, scheinen nichts von einer solchen Änderung anzudeuten, ein Beweis dafür, dass dieselbe sich unendlich langsam vollzieht.«²

Those who use Alexander's chronicles to prove a great change of climate during the last 2,200 years, asserting that in our time it would be practically impossible to take an army along the coast of the Ichtyophags, as Alexander did,

¹ Geographical Journal, Vol. VII, 1896, p. 166.

² Klimaschwankungen p. 323.

should remember that Alexander lost three quarters of his army. And if we compare the old description with the narratives of Sir FREDERIC GOLDSMID¹ and Captain S. B. MILES,² who have travelled the same way in our time, it would be hard to call the climate of the coastland in any way worse now than in 325 B.C. The same aridity, the same heat, sand dunes and occasional rains, the same poor population living on fish and dates and dwelling in miserable huts of the same kind and drinking from brackish wells exactly as in Alexander's time!

WILHELM TOMASCHEK who has compared the descriptions of the Arabian geographers of the 10th and 11th centuries, as Istakhri and MAQDISI, with the modern descriptions of the Persian deserts, arrives at the conclusion: »Aus der Vergleichung ergiebt sich mit Sicherheit, dass die Zustände innerhalb des letzten Jahrtausends auf diesem Gebiete merkwürdig stationär geblieben sind.»³ Tomaschek believes that the oases of Eastern Persia a thousand years ago could not feed more inhabitants than now. From the last 630 years, after Marco Polo's journey, one comes to the same result: the Persian desert is not worse now than then.⁴

Dr. W. F. HUME has obtained the same result referring to the climate of Egypt. »None of the observations recorded in the past give any indication that the climate differed greatly from that of today, and rainstorms were as rare during the time of Herodotus as they are now . . . The regularity in the character of the Nile floods through the long period of time during which they have been recorded also tends to indicate that the conditions now obtaining were those prevalent throughout the historical period in Egypt.» But, regarding the post-glacial changes in general Hume says: »The studies made in Egypt point to conditions in which deposition exceeded erosion, and water-accumulation prevailed over desiccation. On theoretical grounds we should expect that there would be a great reduction of temperature during the glacial period, and the present climate of Egypt is of such a character that such reduction would produce very marked effects in increasing rainfall and the other agents of denudation. He has 8 different points of evidence for the gradual desiccation in post-glacial times, amongst which the former presence of plant-life where desert conditions now prevail, the drying up of the great lakes in the Kharga Oasis, the production of general terraces on the large scale in former days, probably as the result of more frequent rainfall and frost-denudation, etc.⁵

From 20 years' travels in Syria, Palestine and Egypt Professor MAX BLANCKENHORN has arrived at the same conclusions.⁶ Since long ago it has been known that

¹ Journal Royal Geographical Society Vol. XXXIII (1863), p. 181 et seq.

² Journal Royal Geographical Society Vol. XLIV (1874), p. 163 et seq.

³ Zur historischen Topographie von Persien, Part II, p. 3.

⁴ See my: Overland to India, Vol. II, p. 67 et seq.

⁵ Climatic changes in Egypt during post-Glacial Times, in the work of the 11th international Geolog. Congress in Stockholm 1910, p. 421 et seq.

⁶ As to the historical time he says: »Während der historischen Zeit hat sich das Klima Palästinas wie auch wohl dasjenige Agyptens nicht wesentlich geändert. Die in Palästina bemerkbare Aus-

the countries of the subtropical zone, inclusive of the desert regions of North Africa and South Asia, have gone through a pluvial age, which is generally supposed to have been contemporary with the ice age in northern countries. In 16 points Blanckenhorn shows how the pluvial epochs corresponded with the glacial epochs.¹

The same agencies which brought with them a pluvial epoch in North Africa and South Asia, and generally the whole subtropical zone, forced also the glaciers of Himalaya and Kara-korum to increase and advance to much lower levels than nowadays. The original cause has been the same, but while the increased precipitation formed lakes in warmer countries, it accumulated snow and ice in the colder regions, such as the two mountain systems mentioned. On the highland plateau of Tibet the temperature must have been sufficiently low to allow the entrance of an ice age, but even then, and on account of the protection of the southern mountain systems the precipitation has not been sufficient to cover the highland with a cap of ice. There are glaciers, although sporadic, rare and small, all over Tibet, and they advanced considerably at the same time as those of Himalaya and Kara-korum. But otherwise I have in vain searched for any traces of an ice age in the country.

The effect of the increased precipitation is best visible in the beach-lines and strand-terraces of the lakes, of which some have stood at a level 133m. higher than now. During the same period the Manasarovar received a much greater volume of water from its affluents than now, as is also seen from the old fluvial terraces of Tage-tsangpo and Samo-tsangpo. The surface of the lake does not need, however, to have stood much more than 2m. higher than in 1907. Through the channel of Nganga or Ganga the lake was continually drained and kept at a constant level.

In the same way the Rakas-tal was constantly filled, and the Satlej flowed out of this lake, already here a mighty and rushing river, strong enough to cut out the deep valley past Laling-tak and Dölchu-gompa. This state of things may have undergone periodical changes corresponding to the glacial and inter-glacial periods. At that epoch nobody would have been in doubt where the real source of the Satlej was situated. For the Tage-tsangpo comes from the Himalayan side which is higher and more exposed to the precipitation, and therefore able to give rise to the greatest river. The relative volumes of different affluents must have been the same as now. Therefore I have called, and still regard the source of the Tage-tsangpo as the genetic source of the Satlej.

The pluvial epoch however, proceeds towards its end. The salt lakes of the highland plateau have dwindled gradually and left behind a series of strand terraces. The Manasarovar and Rakas-tal still have nearly the same outlines as before, although their levels are sinking slowly and irregularly. Finally the historical time sets in. The scholars I have quoted above, except Huntington, agree that the historical time

trocknung des Bodens ist wie in allen Mittelmeerlandern als Folge der Abholzung der ehemaligen Walder durch den Menschen zu erklären.»

¹ Das Klima der Quartärperiode in Syrien, Palästina und Agypten, ibidem p. 425 et seq.

is too short to make it possible for us to use its records for proving climatic changes. The most that can be shown is periodical changes between moist and less moist epochs, as in the case of the Caspian. If now 2,200 years is too short a space of time for Baluchistan and Southern Persia, much cannot be expected from the meagre records embracing 200 years which exist for the Manasarovar and Rakas-tal. But even within this short space of time the two lakes afford us not only a possibility, but also an excellent opportunity to prove the existence of changes in the amount of precipitation with a rather short periodicity. And for readings of that sort the lakes are, as I said before, a most delicate and sensitive instrument. Even here there are two different periods. The one, the maxima of which are indicated by the outflow from the Rakas-tal, is of a higher order than the one where the maxima are indicated by the effluence through the channel from the Manasarovar. For this channel may be in function without any water escaping from the Rakas-tal. Thus several Manasarovar maxima may occur between two Rakas-tal maxima.

Above and beyond the Rakas-tal period it would be impossible to tell how many still higher orders exist. But above all there stands the great curve of desiccation going on during the whole post-glacial, or post-pluvial period. It proceeds from a maximum towards a minimum. All observed phenomena seem to prove that it still, in our time, proceeds in the same direction. When it has once reached its minimum it will probably again return towards a new maximum.

The oldest records we possess and which may be used for researches in the hydrographical situation, are those which have been saved by Father TIEFFENTHALER and Father GAUBIL.¹ Of them BONIN says: En résumé, ce qui ressort de l'ensemble des croquis qui viennent d'être décrits, c'est la constatation sur les premiers,² qui remonteraient à la fin du XVI^e siècle, de l'existence d'un émissaire du Manasarowar se dirigeant au Nord-Ouest, et sur le dermier,³ qui peut être postérieur, d'une jonction très apparente entre ce lac et le Rakas-tal.⁴ Bonin does not mention the most important conclusion that can be drawn from both maps, namely, that the Satlej also went out from the Rakas-tal. It is less interesting that a communication existed between both lakes, for such was also the case in 1911.

Bonin believes that Tieffenthaler's map of the lakes is from the end of the 16th century, as the Persian legends indicate that the maps date from some of the Great Moguls, probably Emperor Akbar. Thus the map should be from about 1590 and the years of Tieffenthaler's own journeys should not have anything to do with it. It seems, however, that Tieffenthaler has now two sources, the map with the Persian text, and the information he got from a Hindu, who had wandered round the Manasarovar himself. Thus the verbal information should date from the year of the

¹ Vol. I, Pl. LII and LIII.

² Those of Tieffenthaler, Pl. LII.

³ Gaubil, Pl. LIII.

⁴ Les Royaumes des Neiges, Paris 1911, p. 278.

Hindu's pilgrimage, which may have fallen within the years of the Father's travels. The information he got, say about 1760 or 1765, from the pilgrim, namely, that the Satlej went out of the Manasarovar to the N.W., and that a river issued out of the Rakas-tal to the west, was, at any rate, in harmony with the much older map. We have also other statements that there was an outflow from both lakes about 1760.

Gaubil's¹ map published 1729 by Father SOUCIET, is drawn from a Chinese original and seems to date from the journey of the first Lama explorers, or 1711. There was then a channel between both lakes, and a great river, 'Ganga', going out of the Lanka or Rakas-tal. As quoted above Bonin thinks that this map may be later than the one from about 1590; there is no doubt that this is the case.

A much more detailed topography and hydrography is given on the Lama map published by D'ANVILLE in 1733, and with material dating from 1717. His map proves effluence from both lakes. In 1715 DESIDERI indirectly confirms the description of the Lamas.

From 1762 we have the *Shui-tao-ti-kang* or *Outlines of Hydrography*. The compilator CHICHAONAN, may have used material from a much earlier date. From whatever time it is, perhaps the time of the Lamas' journeys, there was outflow from both lakes. Or does the information really date from about 1762?

About 1770 PURANGIR visited the Manasarovar and saw the Ganges flowing out of the lake. Even in the dry season the channel carried water. Here is a case touching only the channel from the Manasarovar. The fact that he calls it Ganges indicates that it has a continuation down to India. The circumstance that it contained water even during the dry season also makes it likely that water flowed out of the Rakas-tal as well. But we can only be sure of the channel.

In 1792 DUNCAN's Fakir remembered that the Satlej issued from the Rakas-tal. He had been on his pilgrimage to the lakes, which may have been in 1770—1780. It is, however, unlikely that the Fakir ever visited the Rakas-tal, as it is not included in the pilgrimage. He has seen the channel only, and heard that it was the Satlej, and that this river also left the Rakas-tal.

HARBALLABH, Moorcroft's old Pundit, had crossed the channel between the two lakes on a bridge in 1796, and in support of the truth of his assertion he could produce the evidence of all the inhabitants of the neighbourhood.

ALEXANDER GERARD obtained positive information that 'about 20 years ago' a rapid stream, crossed by bridges, ran from the Manasarovar to the Rakas-tal, and that this channel had since dried up. As Gerard's statement is from 1817—1818, he speaks of 1797 or 1798 as the date when there was still water issuing from the Manasarovar.

This statement is confirmed by Moorcroft's 'Ladaki Traveller', who asserted that '8 years ago', or in 1804, the stream actually existed. But since that time the channel had dried up and its bed filled with sand.

¹ Vol. I, Pl. LIII.

The last statement was again confirmed in 1812 by Moorcroft himself, who, although he specially searched for it, could not find any channel at all, not even a dry bed. This proves that the Ladaki Traveller must have been right in saying that the bed was filled, and thus hidden by sand.

During his journey in 1814 HAMILTON met a certain Hariballabh who had been at the lakes in 1796. He said that the Rakas-tal received the water going out from the Manasarovar, and asserted that each lake had an issuing river. As this man is obviously the same as Moorcroft's Harballabh, we do not need to consider him further. In the table lower down I have put a note of interrogation regarding the effluence from the Rakas-tal, which indeed is more than doubtful.

In 1816, Captain WEBB was told by the *Deba* of Taklakot that the Manasarovar had only one effluent to the Rakas-tal, a channel, which, however, was often dry. As it is specially pointed out that the channel was often dry, it may be regarded as pretty certain that it really *was* dry in 1816.

In 1817—1818 Alexander Gerard inquired of more than one hundred people who had been up the Satlej. All the accounts agree that the largest stream issues from the western corner of Rawun Rudd or Langa, and, even close to that lake, it is stated to be 30 feet broad and 1' 4 deep in the dry season, and very rapid. Gerard also states that in the hot weather this river is very considerable.

The following statement of HERBERT, in 1819, seems to corroborate the above. He heard from the Lama of Dabling that in the rainy season the two lakes communicate. The Lama also asserted that the Satlej originates from the Manasarovar and goes through the Rakas-tal. If this statement were to be relied upon, it would prove that there may be effluence from the Rakas-tal, even when the channel from the Manasarovar carries water only in the rainy season.

Lieut. J. D. CUNNINGHAM, who wrote in 1843, could not satisfy himself that the two lakes communicated, although according to tradition this had been the case. He received information that the Rakas-tal gave rise to *no* river. He calculates the rise and fall of the Manasarovar at 6 or 7 feet, and under such conditions there cannot be any egress of water from the lake. It is not said in which year he got his information, which only a few years later was proved to be quite wrong.

From October 5th, 1846, we have one of the best statements existing. That day HENRY STRACHEY found an effluent, 100 feet broad and 3 feet deep, from the Manasarovar to the Rakas-tal. On the other hand he found no visible or superficial outflow from the Rakas-tal, and the only effluence was by filtration through the porous soil; but he thinks that at times of extreme flood there may be an overflow. This is an interesting case, showing that in spite of so much water streaming to the Rakas-tal even at a rather late season, no water left this lake.

In 1848, RICHARD STRACHEY visited the channel and found a stream running from the Manasarovar to the Rakas-tal.

In July 1865, Captain SMITH and Mr. HARRISON visited the lakes. Their narrative is very unreliable, but as they positively assert there was not the slightest trace of any stream or old water-course connecting the two lakes, it at least seems likely that the channel was then as dry as in Moorcroft's days.

On NAIN SING's map, 1866, there is no channel between the two lakes, but an effluence from the Rakas-tal to the Satlej, which is of course absurd, as the upper lake under all circumstances is the chief recipient of the water, which, if in sufficient quantity, lower down flows out from the Rakas-tal.

MONTGOMERIE's Pundits coming down from Western Tibet to the Manasarovar in 1868, made a map of the lake and found that no water flowed through the channel.

KAWAGUCHI's statements cannot be used, but he has two interesting things to tell from his visit in August 1900. He was told by the Tibetans that the Langchen Khanbab started from Lake Manasarovar. There was also said to be a connection between the two lakes every 10th or 15th year. From his description as a whole one gets the impression that there was no water in the channel. It is of interest, however, that even the Tibetans pointed to the lowest order of periodicity, giving it an amplitude of 10 to 15 years.

In December 1904 RYDER found the level of the Manasarovar only 2 feet below the threshold of the channel bed, and was told by the Tibetans, that every year during the rainy season there was a flow. As the surface, even so late as in December, stood so high as only 2 feet under the culmen of the bed, it seems almost certain that in September it must have been somewhat more than 2 feet higher that is to say, overflowing; so much the more as the Tibetans stated this to have been the case, meaning probably during the 2 or 3 last years before 1904.

Ryder also heard that the Satlej went out of the Rakas-tal before 1845. In 1904 there was no water in the bed until 6 miles from the lake, where marks and furrows in the bed proved flowing water from east to west. This may have been from the same springs which I saw three years later.

In 1905 SHERRING found the channel without water and the bed sanded up. He heard that no water had flowed through the channel since 1894, a tale that is not in harmony with Ryder's information. Sherring also heard of an underground outflow from the Rakas-tal. This belief is very common amongst the Tibetans, as I found, and very likely they may be right. The year 1905, was, as Sherring says, exceptionally dry.

In 1907 I found the channel dry and, of course, no outlet from the Rakas-tal. The surface of the Manasarovar was 13.45m. above that of the Rakas-tal, and 2.263m. below the highest point in the channel bed. Thus 1907 was a much drier year than 1904, when there was a difference of only 2 feet, even so late as in December.

In 1908 there was no effluence either from the lakes, but as that year was much richer in rain, the surfaces of the lakes must have been at a higher level.

In the year 1909 abundant rains occurred in Western Tibet, and water began to flow through the channel from the Manasarovar to the Rakas-tal.

The rains were still stronger in 1910, and a rushing stream flowed down through the channel.

In June and July 1911 there was no water in the channel, but in the autumn of the same year water was running from Manasarovar to Rakas-tal. In 1912 and 1913 the channel remained dry. From 1909 to 1911 there was no water flowing out of the Rakas-tal.

In the following table I have brought together the above-mentioned material; + signifies outflow; — no outflow:

Year.	From the Manasarovar.	From the Rakas-tal.
? 1590	+	+
? 1625	+	+
1711	+	+
1715	+	+
1717	+	+
? 1762	+	+
1760—65	+	+
1770	+	?
1770—80	+	?
1796	+	?
1798	+	—
1804	+	—
1812	—	—
1816	—	—
1817—18	+	?
1819	+	?
? 1843	—	—
1846	+	—
1848	+	—
1849	+	—
1865	—	—
1868	—	—
1900	—	—
1904	?	—
1905	—	—
1907	—	—
1908	—	—
1909	+	—
1910	+	—
1911	+	—
1912	—	—
1913	—	—

A glance at this list is sufficient to show how meagre the material is. All the information before 1812 dates from natives, except in 1765, and only from the last

hundred years do we possess a few European observations. The two first years are unreliable, and the earliest reliable information dates from the Lama surveyors 200 years ago. The years of observation are too irregularly represented to allow us to draw regular curves. In the 18th century there is a gap of nearly 50 years without records, and there may possibly be a depression in the Rakas-tal curve, or in both. In the first half of the 19th century there is a gap of 25 years, and in the latter half there is one of 32 years, of which nothing is known. From the last 10 years, on the other hand, there are no fewer than seven observations. This uneven distribution of the years over the period in question shows how difficult it is to extract really reliable laws from the material existing.

One thing seems to be evident: a proceeding desiccation during the last 200 years. For, disregarding the more numerous observations of later years, the signs become more numerous as we approach our own time. Do these 200 years represent a fraction of the general post-pluvial desiccation, or do they only represent the accelerated change of climate during a depression belonging to a period of lower order? I believe this latter supposition is the right one, and under such conditions we should expect a return to a maximum during the next 200 or 300 years. But the former supposition is not excluded, if we admit that the lakes are such a sensitive instrument, such a delicate self-registering apparatus, that it would permit us to read climatic changes, which are hardly noticeable on ordinary instruments. Such an instrument we find in the movements of the glaciers. But nobody would pretend that the general post-glacial climatic changes could be controlled by readings within 200 years. This would at least not be possible in Asiatic regions. For we know of passes, as the Mus-tagh, which were used in former times, and now are impracticable. The glacial researches in the mountains north of India deliver abundant arguments for general retreat in post-glacial time. But nothing is known about the speed, and the last 200 years are too short a space of time to prove anything. We can only follow the changes in the period of the lowest degree, the advances and retreats during some 50 years.

The oscillations of the Manasarovar and Rakas-tal, on the other hand, should permit us, if we had the possibility of reading them constantly, to follow extremely closely the curves of at least three different periods. The lowest falls within the course of a year, a rise of the level from the beginning of the rainy season, and a fall from its maximum towards the minimum of the dry season.

The next is the one which may be called the Manasarovar period. It will be well understood if we consider the five years from 1905 to 1910; 1905 was regarded as extremely dry; 1907 was very dry with only very occasionally short rains; in 1908 there was a good deal of rain, specially abundant in July and August, and making all the water-courses, coming down from the north to the upper Satlej, grow into rivers, difficult to ford. In 1905 the level of the Manasarovar must have been unusually low; in 1907 it stood, even during the rainy season, 2.263m. below the highest point in

the bed of the channel; in 1908 it must have been something like what it was in December 1904, or say 2 feet below the same point; in 1909, when the rains were heavy, the level of the lake rose to and above the channel threshold, and water began to flow out of the Manasarovar; finally, in 1910, the rains were very abundant, and the channel bed was filled by a stream.

These dates show a very regular periodicity within a few years.

The next, higher, degree of periodicity is the one we may call the Rakas-tal period. It is seen in the second column of the above list, where + prevails during some 200 years, and is succeeded by — during some 115 years. This period can, of course, also be recognised in the Manasarovar, where there is only + until 1804, and during the next 100 years more — than +. Even when this period is at its maximum, so that there are only + for a long time in the Manasarovar, this lake is affected; but as its level remains nearly constant, one should then be able to take readings only from the volume of water flowing out from the lake.

Such dates as the two + for the Rakas-tal, 1817—1819, may be regarded as very unreliable and unlikely. It is probable that a long series of years must have brought outflow from the Manasarovar, and that great masses of snow must have fallen in the mountains south and S.E. of the lake and north of it, before the Rakas-tal begins to send water down to the Satlej. And from the records we have from the end of the 18th and beginning of the 19th centuries it appears evident that the Manasarovar continues to overflow several years after the Rakas-tal has been cut off. If the rise of 1909 to 1911 grows and continues for many years, it may lead to an overflow of the Rakas-tal, though this is hardly likely, as the rise of 1846 and 1848 did not influence the Rakas-tal in any noticeable degree.

The material I have brought together and examined above, though it does not pretend to be complete, is in any case sufficient to prove that the two lakes belong to the catchment area of the Satlej. My own observations at the place, which, from certain points of view may have been more complete than those of my predecessors, also led me to this conclusion, long before I had had an opportunity to examine the material existing. Col. BURRARD who could only rely upon observations made by others, came to the same result.¹ And still he only uses the observations of Henry and Richard Strachey, and Ryder and Rawling. The connection between the two lakes was discovered by Henry and Richard Strachey in 1846, and has been confirmed by other reliable observers. This connection he takes as established, but that between the western lake and the Satlej basin is still open to question. This is the cause why Burrard and Hayden in drawing the map of the catchment area of the Satlej were in doubt whether to include the lake basin of Manasarovar, though they eventually, and quite correctly, decided to do so. The list given above shows that Burrard is right in saying that even if the water of the Rakas-tal flows into

¹ A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet, Calcutta 1907, p. 162 et seq.

the Satlej only once a century, the lakes must still be included in the catchment area of the river. Even if it be 150 years ago since water flowed out of the Rakas-tal it does not interfere with this hydrographical law.

I have elsewhere¹ touched upon the question of subterranean drainage from the lakes to the Satlej and I have found it likely that the springs in the old Satlej bed at Dölchu-gompa were fed from the Rakas-tal, as well as other springs situated above that point. It is of course difficult to give such a supposition argumental support. Burrard and Hayden seem, independently, to have arrived at the same conclusion: »Henry Strachey was probably right in thinking that the water of the lakes filtered through the porous soil; examples of such filtration are common in the alluvial valleys of the Himalaya. Rivers disappear and subsequently re-appear at the surface. In the underground observatory of the Trigonometrical Survey at Dehra Dun water accumulates in the subterranean drains after heavy falls of rain in the neighbouring hills, even when no rain has fallen locally; the intervening river bed remains dry, and the water flows along an underground course. These underground systems of drainage seem to follow closely the beds of surface streams. The latter hold water only when the volume of flood is too large to sink into the ground, but when the surface is dry, there is often a flow at a lower level.»²

If it is 150 years since the Rakas-tal was cut off, it would appear impossible that its water could still be as fresh as any river water, unless the lake had a subterranean drainage. During those 150 years it has received, as before, affluents, especially from the north, and the channel from the Manasarovar has periodically been in function. It is very likely that underground water has also filtered through the neck of land at one or two places, coming directly from the Manasarovar. Disregarding the smaller periods, the surface of the lake has fallen. Evaporation has been going on. The salts contained in even the freshest river water would have accumulated, and after 150 years there would, probably, have been at least a taste of brackishness, unless the lake were constantly drained and constantly supplied with fresh water.

I had no opportunity to survey the exact height of the culminating point in the old bed of the Satlej above the Rakas-tal. The boiling point gave about 10m., although this value can hardly be used — only one reading being made. If, however, this reading be correct, it should explain the formation of the fluvial terraces along the channel between the lakes. For these terraces are, just below the bridge, up to $2\frac{1}{2}$ m. high; then they become lower and lower, 1m. and less, and near the Rakas-tal they are mere edges at both sides of the bed. At periods when the lake stood several metres higher than now, and when it stood at its maximum and had an overflow, the lower part of the channel from the Manasarovar was inundated, and only in its upper part were the fluvial terraces always carved out by running water.

¹ »Trans-Himalaya» Vol. II, p. 178.

² Op. supra cit. p. 163.

Regarding the drainage area of the uppermost Satlej I differ from Burrard and Hayden only in one point. The Guncho-tso is included on their map. But even if this lake has in former times drained to the Satlej, it is now decidedly cut off, for its water is salt, and the lake is the final recipient in an isolated basin without outlet. Probably in a distant future, when, first the Rakas-tal and then the Manasarovar will become brackish and salt, provided the post-glacial desiccation continues as hitherto, — then the lakes will no more be calculated in the drainage area of the Satlej, but will represent the recipients of an isolated basin without outlet, of the same kind as Panggong-tso, and as so many other lake basins of the Tibetan plateau land. Then the Darma-jankti will probably have to be regarded as the source of the Satlej.

The following is a list of all the rivers which in 1907 brought water to the Manasarovar:

Date of observation.	River.	Volume in cubic metres per second.
July 25	Samo-tsangpo	0.73
July 26	Sarolung-chu	0.10
August 1	Tage-tsangpo	11.26
August 2	Nima-pendö	1.40
August 5	Richen-chu	1.76
August 2	Richung-chu	1.80
August 12	Namreldi	2.86
August 12	Sälung-urdu	1.81
August 19	Pachen-chu	1.98
August 19	Pachung-chu	2.36
August 19	Lugnak-chu	0.50
August 21	Gyuma-chu	2.09

Strictly speaking these measurements are not quite comparable with each other as they have been made on different days. But considering the fact that there were no changes of weather and no precipitation worth mentioning in the summer of 1907 this source of inexactitude loses in strength. All the rivers, except four, were measured at or near the shore. The four measured at the foot of the mountains were the Namreldi, Sälung-urdu, Pachen-chu and Pachung-chu. We have seen that these four rivers dwindled very considerably on their way down. But as the water lost on the way in any case certainly reaches the lake in underground courses, it will give a more exact result if we consider their volumes at the mountain foot.

No other rivers or brooks, except these 12, entered the Manasarovar during the month within which the observations fall, for not an inch of the shore escaped my attention. On the other hand there may of course have been many brooks which were underground the whole way, as well as much filtering water from all sides, except the west. But the water which came under my control amounted in all to 28.65 cub.m. a second, or 2,475,360 cub.m. in 24 hours, if we desist from considering the changes of volume from day to night.

This was during a summer with very little rain. On July 25th, 1907, the Samo-tsangpo had only 0.73 cub.m. On July 23rd, 1908, the same river had 4.89 cub.m., or nearly 7 times as much water, which came down, however, after a very heavy rain. The channel from the two lagoons, receiving Patchen, Pachung and Lugnak, carried on August 20th, 1907, 1.76cub.m. and on July 25th, 1908 at exactly the same place, 4.01cub.m., without being immediately influenced by rain. It is therefore no exaggeration to say that in 1908 three or four times as much water reached the Manasarovar, as in 1907. In the following years the amount was still increasing as we have seen.

The list given above shows that the Tage-tsangpo, with 11.26cub.m., is incomparably larger than any one of the rest. The next largest is the Namreldi from Gurla-mandata with 2.86cub.m. Then comes the Pachung-chu with 2.36 cub.m. Samo-tsangpo comes as No.10 in the list, only two brooks being smaller. Some attempts have been made to award the honour of being the source of the Satlej, to the Samo-tsangpo, or, at any rate, that this river with the same right as the Tage-tsangpo could be regarded as such. But it is not sufficient to look up the map and decree that one river or the other should be accepted as the source of the Satlej. Only actual measurements can decide the question. Now the Tage-tsangpo carries, even at its mouth in the lake, 5 times as much water as the Namreldi at the foot of the mountains, and 15 times as much as the Samo-tsangpo. So there can be no doubt *which* of the affluents to the Manasarovar must be regarded as the source of the Satlej, — from a hydrographical point of view.

It could perhaps be objected that this holds good only for the year in which the measurements were carried out and that the distribution of water may be otherwise in rainy years. But then we only need to remember that the Tage-tsangpo, in a very dry year, was 2 or 3 times larger than the Samo-tsangpo in a rainy year, and just after a heavy rain. And comparisons should of course be made under similar conditions prevailing all over the drainage area. Proportionately the volumes of the 12 water-courses will always and under all conditions be the same as I found them in 1907.

Finally it should be remembered that the historical points of view exactly agree with the hydrographical results.

CHAPTER XXVI.

PRECIPITATION IN N.W. INDIA COMPARED WITH THE OSCILLATIONS IN THE LAKES.

From the records of precipitation in N.W. India available to me I have tried to arrive at some conclusion regarding the relations between the changes in precipitation and the oscillations of the lakes. In his monograph on the *Rainfall of India*, BLANFORD regards the total annual rainfall of the Panjab, taken as a whole, as subject to smaller vicissitudes than that of other provinces in N.W. India.¹ Any drought affecting the North-Western Provinces during the summer monsoon he regards as usually shared by the Panjab, though the deficiency is often compensated by the more copious rainfall in the earlier part of the year.

The period of observations, however, does not reach sufficiently far back to enable us to draw any conclusions. But in Table No.16, Simla,² we find great variations in the rainfall since 1862. Thus in 1867 it was only 52.10 inches, and in 1875 91.39. A regular periodicity cannot be said to exist. In Dehra Dun the observations go back to 1844, and there are differences between 35.11 (1848) and 119.93 (1885). In Katmandu the differences move between 33.18 inches (1864) and 70.38 (1861).

Dr. GILBERT T. WALKER has discussed the problem of the *Meteorological evidence for supposed changes of climate in India*.³ According to Dr. WALKER the comparative weakness of the monsoon in N.W. India after 1894 has given rise to conjectures that the climate had altered permanently in that region. Increase of irrigation or diminution in forests had, amongst other things, been made responsible for the change.

Dr. Walker makes a very interesting comparison between the abundance of the monsoon rainfall of N.W. India and the Nile flood: Of the countries affected by the monsoon the only area for which reliable data extend over a satisfactorily long period is Egypt, where the Nile data extend back as far as 1737 except for a break

¹ Indian Meteorological Memoirs, published by H. F. Blanford. Vol. III, Calcutta 1886—1888, p. 257.

² Ibidem p. 282.

³ Memoirs of the Indian Meteorological Department. Vol. XXI. Part I. Simla 1910.

from 1801 to 1824: of these records the series of 84 years from 1825 is known to be very fairly accurate (Captain H. G. Lyons) . . . Inasmuch as the Nile flood is determined by the monsoon rainfall of Abyssinia, and as the moist winds which provide this rainfall travel in the earlier portion of their movement side by side with those which ultimately reach the north of the Arabian Sea, there is a tolerably close correspondence between the abundance of the Nile flood and that of the monsoon rains of northwest India. It would thus appear legitimate to utilise the Nile data for indicating, at any rate approximately, the character of the variations to which the Indian monsoon is liable.

Dr. Walker's opinion is that a shortage of rain cannot be regarded as indicating a permanent change of climate unless it extend over thirty years at the very least. This opinion he confirms with figures. In 1893 and 1894 the amount of rain increased to a maximum, and then fell suddenly; since 1899 it has again been increasing.¹

So far as I can see, the material existing is too scanty and too unreliable to allow us of any conclusions in comparing the Nile floods, the monsoon rains of N.W. India, and the outflow from the Manasarovar with each other. The first factor of these three is interrupted, the second does not reach sufficiently far back in time, and for the third we possess only very few reliable data. Regarding the outflow in the last 100 years only 1812, 1846, 1848 and 1849 and the few last years are reliable. For the Nile floods records exist, according to Table 3,² from 1737 to 1800, and from 1825 to 1908. Therefore the year 1812 which is so important in the history of the Manasarovar is missing in the Table of the Nile floods. From 1846 we note, for the Nile floods, + 10, in percentage departure from normal, and from 1848 + 12; both these figures agree with Strachey's observations on the Manasarovar effluent. In 1904, when Ryder suspects an outflow, we have - 25 for the Nile floods; in 1907 - 40, but in 1908 + 10, indicating a new rise of the curve.

Table 4: *Monsoon rainfall departure of N.W. India, June to September*, begins with the year 1863, and so we miss even the two important years 1846 and 1848. In 1865 the departure was - 5.09", and 1868 - 3.57"; in both these years there was no outflow from the Manasarovar. In 1904 we have - 9.93", which makes it very unlikely that the Manasarovar could have had an outflow about that time. In 1907 we have - 0.14" and the Manasarovar very low. From 1897 the departure was - for ten years with only two exceptions: 1900 with + 1.93", and 1906 with + 1.81". This period of negative departure has forced the lake to sink gradually. In 1908 again we find + 9.42", still causing no outflow, but preparing the rise of the lake.

¹ »Summing up, it may be said that although there is no proof of any permanent climatic change there has been a tendency over a large part of northwest and central India for rainfall during the past thirty years a) to increase to a maximum between 1892 and 1894, b) to sink to a minimum in 1899, and c) to improve slowly since that time.» Op. cit. p. 5.

² Op. cit. p. 9.

For the last three years, from which records are available, we find: 1909 + 4.00, 1910 + 2.15, and 1911 — 12.90.¹ The outflow from the Manasarovar was established in 1909, and strong in 1910 in spite of the decreasing rainfall in N.W. India from June to September, which would seem to indicate a delay in the effect of the rainfall. But here no doubt several other factors make the problem much more complicated than it seems to be. The annual rainfall in the Panjab for 1909, 1910 and 1911 diminished in a less strong degree, namely, from 24.75 to 21.77 and 19.42. For the two preceding years, 1907 and 1908, the figures had been 19.21 and 28.95. Other tables, from other parts of India, show a rise from 1907 to 1908, in some cases a very considerable one.

There is also another factor of very great importance. Dr. Walker writes in a letter to me, February 1913: A certain amount of snowfall occurs in that region of the Himalayas (N.W.) from our monsoon, but my belief is that most of the snow falls during the winter and spring months (and even in May and June) from depressions like those which give us our winter rains in northern India.² At another place³ Dr. Walker says: The cold weather storms of northern India are of considerable agricultural importance; their rainfall determines largely the character of the great wheat crops of northern India, and they provide the chief part of the snowfall whose melting feeds the irrigation canals during the hotter months of the year.

The following table on *Probable departure from normal of snowfall in the Western Himalayas*, shows, for April and May, a considerable amount of snow before the last rise of the Manasarovar:³

Year.	April.	May
1900	+ 1.0	+ 1.0
1901	+ 1.0	+ 0.5
1902	+ 0.5	0
1903	+ 0.5	+ 1.0
1904	- 0.5	+ 1.0
1905	+ 0.5	0
1906	+ 1.0	+ 1.0
1907	+ 1.0	- 0.5
1908	+ 0.5	+ 1.0
1909	+ 1.0	0
1910	- 0.5	- 0.5
1911	0	0
1912	- 0.5	+ 0.5?

¹ I am indebted to Dr. Gilbert T. Walker for being able to use the figures from 1909 to 1911 before their publication. For this great kindness I express my sincerest thanks.

² Memoirs of the Indian Meteorological Department, Vol. XXI, Part VII. Simla 1913, p. 1.

³ Scale: 0.5 = slight; 1.0 = moderate; 1.5 = great.

The same result is given by the table of *Rainfall departure of Northwest India*:¹

Year.	January.	February.	Period December to March.
1900	+ 0.23	- 0.21	- 0.43
1901	+ 0.53	+ 0.21	+ 1.21
1902	- 0.41	- 0.36	- 1.11
1903	- 0.24	- 0.39	- 0.63
1904	+ 0.01	- 0.22	+ 0.73
1905	+ 0.21	+ 0.27	+ 0.27
1906	- 0.41	+ 1.53	+ 1.39
1907	- 0.14	+ 1.33	+ 1.16
1908	+ 0.40	- 0.10	- 0.37
1909	- 0.26	- 0.07	- 0.80
1910	+ 0.18	- 0.33	+ 0.10
1911	+ 0.81	- 0.40	+ 1.66
1912	+ 0.25	- 0.27	- 0.47

The last column shows that during the period 1904 to 1907 N.W. India got a greater amount of rain than usual during the cold weather. It may be regarded as probable that during the same period more snow than usual fell in the N.W. Himalaya and round the Manasarovar. The snow masses thus accumulated in the mountains forced the lake to rise in 1909 to 1911, in spite of the negative departure which entered in 1908 and 1909. The latter fact also indicates that an accumulation of snow does not show its effect immediately, but only some three or four years afterwards. Thus, for instance, the lake stood unusually low in the years 1906 and 1907, when the positive departure was at its maximum with + 1.39 and + 1.46.

The above figures indicate a certain parallelism between the precipitation in N.W. India and Western Himalaya, — and the outflow or isolation of the Manasarovar, a parallelism which, of course, *must* exist. But the data we possess regarding the behaviour of the lake are too meagre to allow us to draw absolutely reliable conclusions, and at our present state of knowledge, it would probably be impossible to say whether the monsoon rains or the cold weather storms in N.W. India are the most important factor affecting the rise and fall of the lakes, and the volume of water in the rivers.

¹ These two Tables were put at my disposal by Dr. Gilbert T. Walker, before they were printed.

CHAPTER XXVII.

THE MOVEMENTS OF THE KUMDAN GLACIERS COMPARED WITH THE OSCILLATIONS IN THE LAKES.

The historical records we possess about the heights to which different glaciers in the Himalayas and Kara-korums reached at different epochs are unreliable and insufficient. And in most cases they do not reach any further back in time than the memory of man. Therefore they do not permit us to decide whether the hydrographical fluctuations of the lakes belong to a category of phenomena which include the whole of the Himalaya and Tibet.

The natural remains, on the other hand, involve the whole post-glacial epoch. A map of these mountains, showing the present extensions of glaciation, and giving the situation of every old moraine would tell us that all the glaciers have retreated since the glacial or pluvial epoch. In some cases we should be told that a certain glacier some 50 or 60 years ago proceeded to a certain front moraine wall, from which it nowadays may be separated by a considerable space of ice-free ground. But all attempts to find out a periodical advance and retreat from old moraines must so far be regarded as hypothetical and uncertain, and in some cases not harmonizing with general rules in the glaciated region regarded as a whole.

There are, however, a group of glaciers, namely, the Aktash and Kumdan glaciers at the right or western side of the upper Shayok, which on account of the surrounding topography and on account of its immediate neighbourhood to the caravan road between Ladak and Eastern Turkestan, present us with an opportunity to examine the periodical movements of the glaciers, backwards and forwards.

Such an examination, of great interest and value, has been made by Dr. T. G. LONGSTAFF, from whose report I will quote the following extracts.¹

The Kumdan glaciers rise in the neighbourhood of peak K₃₂ and flow at right angles into the valley of the Shayok. During their minor cycles of advance, one or more of these glaciers have on different occasions thrust their snouts right across the course of the Shyok river, only to be stopped by the great cliffs on its

¹ "Glacier Exploration in the Eastern Kara-korum," Geographical Journal, Vol. XXXV. June 1910, p. 647 et seq.

left bank.¹ The historical evidences supplied by writers of the last century and sifted by Longstaff are: ELPHINSTONE, VIGNE, CUNNINGHAM, THOMSON, HENRY STRACHEY, SHAW, DREW, GORDON and BELLEW. Strachey heard of a big flood in about 1780, caused by the breaking of the glacier snout by the pressure of the glacier lake above. In 1812, and probably earlier, the Kumdan route was open and remained so till about 1824, some time after which date it was closed by glacier advance. In 1835, 1839 and 1842 floods again occurred. The region appears to have been surveyed by E. C. RYALL in 1862; the Aktash glacier is marked one mile, and the Kichik Kumdan half a mile, back from the river. Longstaff thinks that the evidence we possess points to advance of the two larger Kumdan glaciers being by no means synchronous with that of the two smaller Aktash glaciers, and hence we can form but a rough idea of their periodicity of advance and retreat. Flood-periods occurred in 1780, 1833—1842, and 1903 — that is, at intervals of between fifty and sixty years. The Kumdan route was probably open before 1800. It was closed from about 1825 until about 1860. It was again usually open between 1865 and 1902. He finds the open periods to last for about 35 years, and the only complete closed period that we know of also lasted about 35 years, but he thinks that this agreement with BRÜCKNER's periods is largely a matter of accident.

Captain OLIVER told him that CHURCH and PHELPS, about 1894, were probably the last European caravan to traverse this route.¹ In about 1899 the building of a road up the valley was arrested by the advance of the Kichik Kumdan. Until the winter of 1902—3 traders continued to make use of the Kumdan route during the cold weather, passing round the snouts of the two Kumdan glaciers by wading or fording when necessary. In the winter of 1902—3 the Kichik Kumdan advanced rapidly, and completely blocked the route.

We shall return to the latest years presently. First I will mention those travellers who have passed this way up, adding a few names to the list quoted above.

In 1533 the Kumdan road seems to have been closed, for SA'ID KHAN GHAZI died on the Murgo road during his journey that year.

In 1812 MIR IZZET ULLAH had his camp on the right side of the Shayok, where the glaciers are situated, and could pass without touching them at all. They seem to have been unusually far back that year. When Mir Izzet Ullah made his second journey, in 1821, the road was probably also open.

From POTANIN's communication about *The Frontier Trade in 1824—28* VENIUKOFF mentions a road *via* Yapchan, Kumdan and Sasser. Thus, if the very years 1824—28 are meant in the report, the statement should prove that the road was open, and the glaciers not blocking it up.²

¹ I passed the road in 1902, on April 21st. I have discussed this question in a paper "The Kumdan glaciers in 1902," Geographical Journal, August 1910, p. 184 et seq.

² The original works from which this and the following quotations are taken, will be referred to in the chapters on exploration in the Kara-korum, Vol. IV.

AHMED SHAH, 1852—53, says that the Kumdan road was blocked from 1818 to 1840 by a glacier. He had to cross its snout. About 1852 the Kumdan road was still the ordinary one, and had been open from 1840 to 1852—53. But from 1840 the glacier had begun to advance and approach the river, and, finally in 1852—53 reached the very foot of the mountains. That is why Ahmed Shah had to cross over the snout. This statement does not agree with the preceding one. If it be right, the Trade Report for 1824—28 refers to material from some years earlier.

On VIGNE's map of 1842 there is the word "Glacier" written at the place where Kichik Kumdan goes down. The principal source of the Shayok comes from Khundun Tsoh Lake or Kumdan-tso. When the ice dam of the glacier was broken by the pressure of the water one of the disastrous floods must have occurred and the road become cleared.

On HUGEL's map, drawn by ARROWSMITH in 1847, there is no Murgo road, only a »Khamdan road, showing that the passage was not closed.

On his way back from the Kara-korum pass, in August 1848, THOMSON paid a visit to the glaciers and gave a good description of them, so far as he could proceed and was able to see them. He saw the Aktash and Kichik Kumdan entering the bed of the Shayok and crossing the river which flowed out from under the ice. As the Kumdan road was closed by the glaciers, Thomson travelled the Murgo-road. From Yarkand merchants he heard that 10 or 12 years earlier, 1836—38, the glaciers had blocked the road which had previously been trafficable.

In the narratives of the SCHLAGINTWEITS I cannot find the Kumdan glaciers mentioned, which seems to indicate that the road was blocked at the time of their journeys, or 1854—58. Only in their *Route-Book of the western parts of the Himalaya, Tibet, and Central Asia*, do they mention the winter route from Sasser to the Kara-korum pass, as passing Khumdan, and Gyápschan, but as the material for this itinerary is taken from Mir Izzet Ullah, it does not help us at all.¹

If on RYALL's map of 1862 the Chong Kumdan is shown as closing the road, this seems to be in agreement with DREW, who mentions the winter road *via* Burtse, Kisil-unkur and Dovlet Bek-öldi, taken from *The Panjab Trade Report* 1862, a road which would hardly have been mentioned if the Kumdan road had been in use. It would also be in agreement with the report of MONTGOMERIE's MUNSHI MAHOMED-I-HAMID, who, in 1863, passed over Sasser, Murgo and Dapsang to the Kara-korum pass, a road that is never taken if the much easier Kumdan road is open.

JOHNSON travelled down the Kumdan road only two years later, or 1865, passing some large glaciers, and following the right bank of the Shayok. He obviously did not touch the ice at all, so the retreat of the glaciers seems to have been considerable.

¹ Results of a Scientific Mission to India and High Asia, by Hermann, Adolphe and Robert de Schlagintweit, Leipzig and London 1863. Vol. III, p. 106.

In 1869 SHAW also went down the same way. He saw one glacier protruding from a side valley, causing a difficult ford. About 3 miles lower down another glacier, Kichik Kumdan, blocked the way right across to the opposite rocks. Shaw crossed the glacier on foot, but had to send his ponies round by Murgo.

In the autumn of 1873 the members of the FORSYTH mission did not meet any great difficulties, for the Kichik Kumdan and Chong Kumdan did not block the valley completely. The travellers could pass through a narrow passage in water between ice and cliffs. They had not to pass over ice at all. The Chong Kumdan was easier to get past than the Kichik Kumdan.

In 1874, J. SCULLY travelled from Leh to Yarkand, *via* Kardong, Tagar, Panamik, Changlung, Sasser and Murgo. From his camp at Sasser, 15,224 feet high, and some 400 feet above the level of the Shayok river, he saw, in front, a range of high and barren rocky mountains forming the eastern side of the valley; to the left the course of the river can only be seen for a short distance where the Shayok valley seems to be blocked up by an enormous glacier called Kumdan.¹ As he followed the Murgo and Kisil-unkur road, the Kumdan road had therefore, in the course of a year, been completely closed.

In 1889 and 1890 YOUNGHUSBAND travelled from Sasser to the Kara-korum pass along the Shayok.

In the end of October 1892 DUTREUIL DE RHINS and GRENAUD passed the Kichik and Chong Kumdan. They had to ride in the water along the edge of the snouts, without crossing any ice.

In 1898 NOVITSKY passed this way. He knows only one glacier which he calls Chum Khumdan. He had no difficulty at all in passing, for he went on the right side of the river and had no ice to cross. There must have been a very strong advance in the following four years.

In April 1902 I travelled the way northwards, and could still pass, though with some difficulty.² Already the next year CROSBY and ANGINIEUR had to take the Murgo road so far as can be seen from their meagre reports. In December 1907 and in 1908 STEIN had to follow the Murgo road as the Kumdan road was closed. In 1905 even the Aktash glacier is reported to have advanced across the river-bed.

¹ »A Contribution to the Ornithology of Eastern Turkestan», in *Stray Feathers, a Journal of Ornithology for India and its dependencies*, Calcutta 1876, p. 41 et. seq.

² »We were now approaching the locality which we had been warned against in Shayok, as in some years rendering this route impassable. The most advanced frontal section of the Kichik Kumdan is pushed right across the glen until it encounters the precipitous rocky wall on the opposite or left side. Hence, in order to get past it, you have to climb partly over small, steep rocky heights and partly over a chaos of icy fragments, which have toppled down from the front of the glacier and form a veritable ice moraine, the separate pieces of which have become rounded on the outside through partial thawing. In some places they have cemented themselves together into a single compact mass, in which appear dark, gaping holes. At the time of our visit the true glacier front did not actually touch the opposite rocky wall. In consequence of the radiating heat, the melting of the ice was just

Captain OLIVER, who had visited the glaciers in 1908, accompanied Longstaff in August 1909, and they found the passage still closed, now by three glaciers. Their observations seem to prove that the Aktash and Chong Kumdan glaciers had advanced somewhat during the $7\frac{1}{2}$ years since my visit to the place.

The last information I have received, is a letter dated June 1911 from GULAM RASUL, which runs as follows: All the traders and caravans from Leh to Yarkund go by the way of Murgo on the east. They also passed by the way of Murgo in 1909 and 1910, as it is impossible to travel by the way of Kumdan, the glaciers (having) closed the road.

The above extracts from reports of different times show how difficult it is to arrive at any reliable conclusions from the material existing. Only a few of the earlier narratives are sufficiently clear to be well understood. The expressions 'open' and 'closed' may also give rise to misunderstandings. For in late autumn, winter and spring the way may be open, even if the Kichik Kumdan nearly touches the opposite cliffs, but closed the next summer when the narrow passage is filled with water, and in spite of the glacier not having advanced at all.

In the following list the second column chiefly shows whether the road of Kumdan was practicable or not, or, that 'closed' means that travellers had to take the Murgo route. The third column contains the results at which Longstaff arrived:

at that spot intensified, and, in fact, there was a narrow passage left by which we were able to advance. It was, however, excessively contracted, sometimes only 10 metres across: and it was perfectly plain that it needs but a slight increase in the glacial activity, such, for example, as one or two snowy winters followed by warm, bright weather, and this passage would be completely stopped, and it would be absolutely impossible to advance by that route. But the condition of things changes from year to year, and this is what our Ladakis meant when they said they could not guarantee that this route would be practicable that year. Had the passage been blocked by the ice, we should have been forced to make the three days' *ditour* to which I have already alluded. However, the road was open, though there was only just room for us to get past without lifting the loads off the horses; and, strange to say, we succeeded without having a single leg broken in the deep holes that gaped between the ice and the fragments of rock.

After that we continued north-west up the glen, marching sometimes on the gravelly bottom, sometimes on the sheets of ice, until we came to the still bigger glacier-arms of the Chong Kumdan. These do not, however, stop up the road, although there is but little room to spare. Their front, abruptly broken, almost vertical, indeed, sometimes overhanging, is, in general, 20 metres high. The whole of the glen was here sheeted with ice, formed from the thaw-water. This glacier possesses far more moraines than the former, and a large portion of its arms is completely covered under grey detritus, through which the base rock projects here and there. The ground-moraine appears, however, to be more developed than the top or side moraines, so far, at least, as it was possible to judge from the front of the glacier. It is surprising that there exists no trace of any frontal moraine; but not even the smallest ridgelet of gravel is thrust forward by the ice. Yet such must inevitably be formed at times, though where they are forced by the pressure of the ice behind out into the middle of the rivulet that leaves the glacier, they are soon worn down and carried away by the water. From our route we were not able to see anything of the 'firn' region from which the ice-streams of the Kichik Kumdan and the Chong Kumdan are fed; we could not even see the tops of the glaciers themselves. Yet judging from the size of the glaciers in front, it is fair to infer that the gathering grounds of the ice must attain pretty large dimensions.¹ Scientific Results of a Journey in Central Asia 1899—1902, Vol. IV, p. 410 et seq.

1533	closed	
1812	open	1780 closed
1821	open	Before 1800 open
1824}	open	1812—1824 open
1828}	open	Sometime after 1824 . . . closed
1818}	closed	1833—1842 closed
1840}		1825]
1836}	nearly closed	
1838}		
1840}	open	· · · · · closed
1850}		
1842	open	
1847	open	
1848	closed	
1854}	closed	
1858}		
1862	closed	1860
1863	closed	
1865	open	1865
1869	closed	
1873	open	
1889}	open	
1890}		· · · · · open
1892	open	
1894	open	
1898	open	
1902	beginning to get closed	1902
1903	closed	
1904}	closed	
1911}		

Comparing the two columns we find that the 35 year cycles nearly disappear — in my list, which gives instead a more irregular periodicity. As a rule the two columns run fairly parallel with each other, although I have exceptions from Longstaff's closed period of 1825—1860. From his open period 1865—1902 there is only one exceptional year.

The list has the same fault as the above list on the effluence from the lakes: it is incomplete. Therefore a comparison between both leaves much room open for uncertainty. Theoretically it is very easy to say that there *must* be a certain parallelism between both classes of phenomena. For as Longstaff says: »It is probable that the explanation of such periodic glacier variations as I have described must be sought in the periodic variations of rainfall«, therefore nobody can doubt that the oscillations in the lakes and the fluctuations in their effluence exclusively depend upon variations of rainfall. The same original cause influences both the lakes and the glaciers. During a period of abundant rain much water will flow to the Manasarovar and out of it, and perhaps out of the Rakas-tal as well; in the same period more snow than usual will accumulate in the mountains and feed the glaciers which consequently

will advance. During a dry period the lakes will be, at least superficially, cut off, and the glaciers enter a period of retreat.

The parallelism will, however, not be complete, for the advance of the glaciers will always be delayed several years, whereas the Manasarovar will begin to rise the very first year of a rainy period.

Further periods of low order which can easily be followed in the lakes would altogether disappear in the movements of the glaciers. In the lakes we may read the finest oscillations possible, and we can distinguish between the Manasarovar periods with effluence only from the eastern lake, and Rakas-tal periods with effluence also from the western. Such fine distinction would be swallowed up along the length of a great glacier. To this should be added that the advance and retreat of glaciers are also influenced by other agencies than precipitation only, and that the topography of their surroundings may interfere and cause irregularities.

That periodical variations exist in the glacier movements is clearly shown by the instance of the Kumdan and Aktash glaciers. A great amount of more or less reliable information has also been gathered by different travellers. A few examples may be sufficient. VIGNE heard from natives that the snow of the glacier at Arundo was slowly but perceptibly advancing, in 1835. In the Nubra valley THOMSON saw from old moraines that the glaciers had, during some earlier period, advanced much further than in 1848. Similar observations were made by GODWIN AUSTEN, DREW and several others. Longstaff heard that the Chumik glacier had joined the Bilafond about 15 years before his visit. At the snout of the Siachen glacier there were indications of an advance since 1862. The Hassanabad glacier is said to have recently made a very considerable advance. Not long ago the Indian Survey, through the action of DOUGLAS FRESHFIELD and Lord CURZON, has set about measuring typical glaciers in various parts of the Himalaya. In *Les variations périodiques des glaciers* for 1908, published by the International Glacier Commission, we are told that the retreat of glaciers in 1908 is a general phenomenon, embracing the whole earth.¹ MUMIM and STEIN declare that Asiatic glaciers have been decreasing during later years. Only the Kara-korum glaciers should make an exception. It would, however, carry us too far to enter into this problem, which is still far from its definite solution.

¹ T. H. HOLLAND, late Director of the Geological Survey of India, says of the general retreat of glaciers north of India: «The second point prominently displayed is the evidence of general retreat shown by the occurrence in nearly all cases of old moraines (sometimes grass-covered) below the present ice. This point does not, of course, necessarily mean that the glaciers are now in retreat, and two well-authenticated cases of recent advance have been found in the Yengutsa and Hassanabad glaciers, both steep transverse ice-streams. Since 1892, the date of Sir M. CONWAY's visit, the Yengutsa glacier has advanced at least 2 miles, nor does this advance appear to have been gradual, as, according to local reports, the ice moved forward suddenly some five years ago, and has since remained stationary. The Hassanabad glacier, according to the statement of the Emir of Hunza, also moved forward suddenly some three years ago, covering in two and a half months a distance variously estimated as from 6 miles to one day's march. Owing to the danger involved to the villages near, it was carefully watched, and the above statements may, we are told, be accepted. It is said that the ice occupied its present position many years ago, and subsequently retreated. It is now apparently stationary.» — Observations of Glacier movements in the Himalayas. Geographical Journal, March 1908, Vol. XXXI, p. 315.

If the advance of the Kara-korum glaciers is really a fact, one would expect to find a period of growing and strong effluence from the two lakes, or at least from the Manasarovar. But such a period can hardly be found in the list given above, unless we go back to 1846 and 1848 and admit that the effluence may have continued for several years after the visit of the Stracheys. We must also consider that between 1868 and 1900 there is a gap of 32 years which may easily have contained a maximum.

Still, comparing the two lists, some conclusions may be drawn. In 1780 there was a flood in the Shayok proving that the valley had been closed by the glaciers. This agrees well with the lakes, for all reports we possess from the time before 1780 indicate effluence from both lakes. From 1848 till 1863 the Kumdan route was closed by the glaciers, which agrees with the observations of the Stracheys in 1846—48, when the Manasarovar had even effluence. Then follows the period from 1865 till 1902 when the Kumdan road was almost always open, which is in excellent agreement with the lakes which from 1865, or earlier, till 1908 had no effluence, except in 1904, although doubtful. From 1903 to 1911 the Kumdan route has been closed, a fact for which we do not find any correspondence in the oscillations of the lakes, though we again have to remember the gap from 1868 till 1900. The rise of the lakes which carried with it an effluence in 1909, 1910 and 1911 will, if it continues sufficiently long, probably be followed by a new closed period on the Kumdan route, after a certain elapse of time.

The results I have obtained from this examination at least show that the variations in the rainfall directly and periodically influence the hydrography of the two lakes, as well as certainly all other lakes in Western Tibet, and the movements of the glaciers. In the old moraines we find the mile-stones on the way of post-glacial desiccation. Therefore *a priori* a diminution in the effluence from the lakes must have taken place during the same period. The 200 years, within which we possess the only reliable dates regarding the lakes, probably indicate a period of much lower degree than the general post-glacial desiccation. And therefore we have no cause to exclude the possibility of the Satlej's flowing out again from the Rakas-tal.

The climatic variations which have taken place during the last 200 years have, of course, not had the slightest influence on the conditions of the nomads, as a whole. From Father DESIDERI's narrative we find that the nomads lived, in 1715, exactly as nowadays. But, on the other hand, even periodicities of such a low degree as those which I have called the Manasarovar period, for instance from 1907 to 1909, influence the nomads so far, that 1907 was regarded as an unfavourable year, as no rain fell and the grass remained very sparse and bad, from which the sheep, yaks and horses had to suffer. In 1908 the conditions were already improved and in 1909 and 1910 were very satisfactory. During such years the flocks are kept in excellent condition and the wealth of the nomads increases. During a period of several dry years their life becomes a hard struggle. Therefore it may with some reason be said that the changes in rainfall also give rise to variations in the conditions of life amongst the Tibetans.

CHAPTER XXVIII.

THE TSO-MORARI COMPARED WITH THE MANASAROVAR.

In his article quoted above: *Observations on the Spiti Valley and circumjacent country within the Himalaya*,¹ Dr. J. G. GERARD compares the hydrography of the Manasarovar with that of the Chumoriri or Tso-morari, and it may be of some interest in this connection to make a short review of the history of the latter lake as reported by a few prominent travellers from different epochs.

Gerard found that the Tso-morari had no passage outward, though it was fed by considerable streams. In the dry atmosphere the evaporation would be sufficient to graduate the marginal limit of Tibetan lakes to the extent of 4 or 5 feet. Gerard travelled one day along the lake and camped at its eastern extremity. He saw no watermark above 5 feet. His visit fell at the end of September, so he considered the 5 feet as the limit of fluctuation, a circumstance which had been assumed by theorists in regard to Manasarovar as proving the reverse of what Mr. Moorcroft asserted, or that there must be a drain from the waters of the lake. The Tso-morari had no efflux either, and evaporation preserves the balance; he found it more surprising that any water should remain at all, than that no outward communication should exist. In spring the torrents from the surrounding mountains cause the surface of the lake to rise to its maximum limit. By the end of August the lake has sunk to its lowest depression. Mánasarovara is precisely similar, but upon a much larger scale in respect to the volume of its waters, its elevation and magnitude of the scenes around it. The water is well tasted, which would seem to argue some outlet, which the oral accounts of the Lamas would confirm to be that of the Satlej; . . . the waters of Lake Chumoreril (as might be expected from their having no drain) are unfit to drink, though barely differing in taste from that of running streams.

Captain ALEXANDER GERARD, on the other hand, says the Tso-morari has an outlet: The Lee or Speetee river is formed of two large branches that unite below

¹ Asiatic Researches, Part II, Vol. XVIII. 1833, p. 259.

Changrezing: one, named Zungcham, is derived from a double source, that from the snow in Bootpoo range to the N.E. retaining the name common to both, and the Paratee issuing from Lake Chumorereel, a beautiful sheet of clear water eight or ten miles long, and half that in breadth . . .¹

Sir ALEXANDER CUNNINGHAM found no outlet from the lake at present; the waters are consequently brackish, although not very perceptibly so to the taste. But the time has perhaps once been, when the Tshomoriri lake was a noble sheet of fresh water, about 30 miles in length . . . In September 1846 VANS AGNEW and Cunningham estimated the ridge that separates the lake from the Pára river at 700 feet at least, probably 900. Now the rise and fall must not even amount to one foot. The lake had once, as he believes, an exit into the Sum-gal and its accumulated waters were suddenly drained off by the disruption of the Sum-gal barrier.²

HENRY STRACHEY says that the Tso Moriri has no effluence. An elevation of 100 feet at its northern end, with an equal depression at the southern, would, however, send it all into the Rupshu river, along with the river from Pirse, through Leptra to Nurbu-Sumdo. The old idea that the lake actually formed the source of the river, obtained by Herbert and others from distant inquiries, and still figuring on most English maps, though not strictly correct, is thus founded on geographical facts, and a careless observer might mistake the southern branch of the Pirse river for an effluent of the lake. Strachey saw no signs of desiccation in the lake, nor was the existing watershed across the Leptra valley consistent with any considerable height of water above the then existing surface.³

Some ten years after Strachey, HERMANN VON SCHLAGINTWEIT visited the «Mountain-Lake», Tso-morari, in Rupshu, and camped at the southern end of the lake, which he makes 12 miles long and 3 miles broad, the absolute altitude being 15,130 feet.⁴ From his camp he could easily see the parallel beach-lines. The surface of the lake stood, in June, 32 feet below the threshold over which its effluent once passed. Already before the lake began to become salt, it had been shrinking and sinking on account of the erosion of its effluent. He regards the water as still drinkable.

The best description is, however, given by FREDERIC DREW,⁵ who makes the lake 15 miles by 3—5 and at a height of 14,900. The water is slightly brackish and freezes in winter, and there is no outlet. The depth he found to amount to 248 feet in the southern, and 180 in the northern part of the lake; thus the Tso-morari is an ordinary valley dammed by the alluvial fan of a side stream, for the thickness to which such fans were known to accumulate would account for all the depths

¹ Narrative of a Journey, etc. Vol. II, p. 179.

² Ladak, p. 139 and 194.

³ Journal Royal Geographical Society, Vol. XXIII, 1853, p. 51.

⁴ Reisen in Indien und Hochasien, Bd III, p. 142 et seq.

⁵ The Jummoo and Kashmir Territories, London 1875, p. 301 et seq.

observed.¹ He estimates that the lake once reached 40 feet above the present level. At the point where the damming fan abuts against the eastern hills, it would take a rise of somewhere between 50 and 100 feet to carry the waters over it. From the time when the lake was first cut off from all sort of effluence the area of evaporation has been lessened by $\frac{1}{5}$, which was enough to balance the supply from streams and springs, and this is the measure of the increase of dryness. But any amount of change in this direction may have occurred before the lake became an isolated drainage-basin. It may be remarked that on a large evaporation area being formed the water may begin in some degree to get saline even before the outflow has ceased; wherever there is less outflow than inflow there must be concentration of salts, and there will be less outflow than inflow for any lake of large area even if it have an outlet.

This law laid down by Drew cannot be applied to the Manasarovar, and, generally speaking, it is difficult to imagine a lake with more outflow than inflow. If Drew's law were correct all lakes should be salt. The outflow of the Manasarovar is of course always much less than the inflow, and periodically there is no superficial outflow at all. And still the lake is perfectly fresh.

Some years later Major-General MACINTYRE camped at the southern end of the Tso-morari, and found the water to be not salt; on the contrary it seemed to be perfectly good, although rather flat to the taste; but the Tartars had an objection to drinking it. There was a large amount of drainage into the lake but no visible outflow from it. This he considered as a remarkable fact, for evaporation alone could hardly account for the disappearance of the constant and abundant supply of water from the great quantity of melting snow draining into it from the surrounding mountains.²

R. D. OLDHAM cannot entirely accept Drew's theory that the Tibetan lakes should have been formed by the damming up of the main valleys by the accumulation of fans of tributaries which were great in post-glacial times. The formation of such a lake as the Panggong he regards as entirely due to differential movements of the surface, which raised a portion of the original river bed at a more rapid rate than the stream was able to erode, and dammed back the drainage to produce the present lake.

In the case of the Tso-morari to which Drew had specially applied the fan-theory, Oldham thinks that the fan alone could not have caused an interruption of the drainage, had there not been an elevation of a portion of the river valley farther down its course, and a consequent diminution of the gradient. The broad shingle plains found above the points where the rivers enter a gorge, Oldham regards as produced by a check in the gradient, consequent on a recent elevation of the river

¹ Compare Dr. H. H. Hayden's Chapter: On the Origin of Lakes, A Sketch of the Geography and Geology of the Himalaya Mountains and Tibet, Calcutta 1907, p. 202 et seq.

² Hindu-Koh: Wanderings and wild sport on and beyond the Himalayas, London 1889, p. 357.

bed in the gorge, and consequent checking of the gradient immediately above it. These circumstances might well give rise to the formation of an actual lake; the existence of an exit, on the other hand, would depend on the rapidity of the movement, the supply of water, and the nature of the climate.¹

Oldham's view is no doubt applicable to the twin-lakes of the Manasarovar and Rakas-tal as well as upon the twin-lakes of Tso-ngombo and Panggong-tso. The same differential movements which raised the western parts of the Panggong basin at a rate which was too quick for the erosion of the river to follow, may have influenced the valley of the uppermost Satlej in such a way that its two lakes had to be formed. In the bed just west of the Rakas-tal no signs of a damming fan are to be seen, and here the theory of Oldham seems to be the most plausible one.

There is, however, as pointed out before, a great difference in the state of development of these two pairs of lakes, namely, that the Panggong lakes are already definitely cut off from all contact with the Indus system, and therefore forming an entirely independent and self-contained basin. The last recipient of this basin is Panggong itself, which is a salt-water lake.² The eastern lake, Tso-ngombo, has still an effluent to the Panggong and is therefore perfectly fresh. In the case of the Manasarovar lakes both are perfectly fresh and therefore in intermittent communication with the Satlej. From the above quotations we have found that the Tso-morari has slightly brackish water and therefore it is cut off; regarding salinity it thus takes an intermediate stage between the Manasarovar and Panggong. Or, in other words, the salinity of the lakes increases from S.E. to N.W., or, the progress towards isolation from the rivers and desiccation, proceeds quicker the farther N.W. the lakes are situated. This state of things depends, at least to a considerable degree, upon the rainfall in N.W. Himalaya which decreases from S.E. to N.W. Naini Tal has a rainfall varying at different places, from 234 to 280cm., Mussooree has 234, Chakrata 157, Simla 173, Marri 147cm. In the interior valleys and ranges the rainfall is much less. Srinagar has only 94, Almora 96cm.³ The drainage areas of the Tso-morari and Panggong-tso must therefore receive comparatively less precipitation than that of the Manasarovar. The state in which we now find the two first-mentioned lakes probably indicates the direction towards which the Manasarovar proceeds.

¹ A Manual of the Geology of India by H. B. Medlicott and W. T. Blanford. Second edition: R. D. Oldham. Calcutta 1893, p. 481.

² From descriptions of different travellers Hermann von Schlagintweit arrives at the conclusion: »Überall waren es Reste einer früher viel ausgebreiteteren Seebildung; überdies befanden sich die meisten der Seen jetzt in einem eigenthümlichen Zustande stetig zunehmenden Salzgehaltes.» — Untersuchungen über die Salzseen im westlichen Tibet und in Turkistan. München 1871, p. 1.

³ Hann, after Hill. Handbuch der Klimatologie, II Band, I Teil, Stuttgart 1910, p. 220.

CHAPTER XXIX.

THE IMPORTANCE OF GLACIER SOURCES.

Comparatively recently, not yet a hundred years ago, the important part played by Himalayan glaciers as feeders of the great rivers began to be realised. The Indus, Satlej, Karnali, Ganges, Brahmaputra, have all for hundreds of years been derived from the sacred lake. I have proved that the Satlej is a glacier-born river.¹ The Indus, as not coming from glaciers, is, compared with the upper Satlej, Tsangpo, Shayok and others, a mere brook. Should only the volume of water be considered, the Tibetan branch of the Indus, i. e. the Singi-tsangpo, should only be regarded as a tributary.

The Himalayan glaciers have advanced extremely slowly to the important place they really occupy as feeders of great rivers. It would take us too far were we to follow the history of exploration in this direction. But to give an idea of the stand-point of European knowledge at different epochs during the last hundred years, I will quote the views of three prominent explorers.

Captain J. A. HODGSON who, forgetting the Capuchins and Desideri, claimed to have been, on June 21st, 1816, the first European who ever effected a passage over the great Himalaya, had an opportunity, in 1817, to explore and survey the Ganges to a considerable distance beyond Gangotri and to the very place where its head is concealed by masses of snow which never melt.² But as Captain RAPER's account of Captain WEBB's survey in 1808 had already been published he only refers to new ground.

Proceeding up from Gangotri he saw many snow beds, some of which he had to pass. He found the Bhagirathi or holy and celebrated Ganges issuing from under a very low arch at the foot of the grand snow bed; — the river is here bounded to the right and left by high snow and rocks. In front, the mass of snow was perfectly perpendicular and had an estimated thickness of some 300 feet of solid frozen

¹ That the Brahmaputra also comes from glaciers was well known by the Chinese long ago, suspected by Nain Sing, Ryder and Rawling and finally proved by myself.

² «Journal of a Survey of the Heads of the Rivers, Ganges and Jumna.» Asiatic Researches, Vol. XIV, Calcutta 1822, p. 60.

snow, probably the accumulation of ages; — it is in layers of some feet thick, each seemingly the remains of a fall of a separate year . . . The height of the arch of snow is only sufficient to let the stream flow under it.

In this description it is easy to recognise honest, solid glacier ice. Believing this accumulated snow to be the first appearance of the famous and true Ganges in day light, Hodgson measured it, and found it on an average to be 27 feet broad and 15 inches deep.

Then he proceeds to give some account of this bed or valley of snow, which gives rise to the Ganges. He does not find it surprising that the melting of such vast masses of snow in the valley can give rise to the young Ganges. In this manner, all the Himalaya rivers, whose heads I have visited, and passed over, are formed; they all issue in a full stream from under thick beds of snow. He was fully satisfied that even if he had gone farther than he did in the snow bed, he would not again have seen the river, and that the place where it made its appearance, or at the very front of the bed, was the real and first debouche of the Bhagirathi.

He does not think that at the head of the surrounding snowy mountains there can be any practicable or useful pass to the Tartarian districts. And beyond the surrounding ridges he does not believe in the existence of any still higher part of the river or any lake from which it could come, but that the ridge must mark its uppermost frontier.

Hodgson also reached the ice-bound source of the Jumna, and he intended to explore the sources of the Tonse, Sotlej and Jahnavi.

Seeing crevasses in the glaciers for the first time in his life he believed they were formed by earthquakes or hot springs; he suggests that the hot springs may be a provision of nature to insure a supply of water to the heads of the great rivers, in the winter.

Hodgson was an able man and did a wonderful piece of work for his time.¹ The most interesting observation he made was that all Himalayan rivers he had seen were fed by glaciers.

The next example I would give is presented by RICHARD STRACHEY who, in 1847, visited the upper parts of the Pindar and Kuphinee rivers.² He points to the fact that the natural philosophers of Europe still considered the existence of glaciers in the Himalayas a matter of doubt.

¹ Some 60 years later his observations were confirmed by Mr. T. KINNEY, who travelled up the Bhagirathi valley in 1877—78 to supplement Mr. Ryall's survey in the direction of the Nilang valley and the Tsaprang district of Hundes. The Bhagirathi was found to form the westernmost source of the Ganges. CHARLES E. D. BLACK says: »The description given by Captain Hodgson in 1817 fully bears out Mr. Kinney's more recent account.» *A Memoir on the Indian Surveys. 1875—1890*; London 1891, p. 51.

² »A Description of the Glaciers of the Pindar and Kuphinee Rivers in the Kumaon Himalaya.« *Journal Asiatic Society of Bengal. Vol. XVI. 1847*, p. 794 et seq.

Strachey at once observed that the rivers came from glaciers. From the foot of its nearer extremity the river, even here unfordable, rushes in a turbid torrent out of a sort of cave, the top of which when I saw it was but a few feet above the surface of the water. The end immediately over the source of the river is very steep and of a dull black color.

He could not make out whether these glaciers had ever varied much from their actual limits. The shepherds of the place believed they were gradually receding. Strachey believed they had formerly reached much further down.

He gives one extract from Lieut. WELLER who had been to see the source of the Goree, one of the main feeders of the Gogra. The place is situated about a mile N.W. of Milum, and Weller described it thus: The river comes out in a small but impetuous stream, at the foot of apparently a mass of dirt and gravel some 300 feet high, shaped like a half moon. This is in reality a mass of dark-colored ice, extending westward to a great distance, and covered with stones and fragments of rock, which in fact form a succession of small hills.

This report, together with Hodgson's and his own observations is all Strachey had heard about glaciers in the Himalayas, although he says he occasionally comes across descriptions of snow-beds that seem suspicious. But from what he had seen at a great distance, and from what he had heard of his brother Henry Strachey and others, he was fully satisfied of the existence of many other glaciers in the Himalaya.¹

He enumerates several rivers, at the heads of which he could positively affirm that glaciers were situated, most of them rising from Tresool and Nanda Devi. Therefore he concludes that at the head of almost every high valley of the Himalayas that descends from perpetual snow, there must be, as in the Alps, a glacier, and that the Himalayas should be one of the most favourable fields for the investigation of glacial phenomena.²

It is surprising that less than a hundred years ago glaciers were practically unknown in the Himalayas and that such a scholar as ELIE DE BEAUMONT could deny their possible existence. Here, as in so many other fields of physical geography R. Strachey proved to be clear-sighted and strictly scientific and he gave a strong impetus to subsequent researches. In the Kara-korums the case has been the

¹ «Though many an ardent traveller had preceded him, Thomson was the first who clearly distinguished the glaciers of the Himalayan mountains from the snows whence they issued . . .» Sir R. J. Murchison in his address 1864. Journal Royal Geographical Society. Vol. 34. 1864.

² Henry Strachey expresses the following view: «The chief reservoir of Tibetan glaciers seems to be in the southern face of the Turkish watershed, which the joint observations of English travellers and native reports prove to be full of them, and many of the first class both for size and formation. The main trunk of the Nubra river issues from two of these, at a place called Kumdan. I myself found the river of Yarma-Nubra issuing fullformed (being 50 yards wide, with an extreme depth of 1¹/₂ feet, and very rapid, in the beginning of October) from a large glacier, entirely occupying the head of the valley and (so far as Tibetan information goes) rendering it impassable. The Tulumbuti affluent of the Yarma-Nubra river also rises from glaciers . . .» Journal Royal Geographical Society. Vol. 23, 1853, p. 53.

same; Mir Izzet Ullah, for instance, called the Kumdan glacier 'a mountain of ice' which, however, partly depends upon the fact that orientals have no other expression than »ice for a glacier.

It is also worth noting that Strachey, when he first saw a glacier, understood that it was the original feeder of a river.¹ And such he found to be the case with every glacier he knew. The case is the same with the genetic source of the Brahmaputra. The great rivers have, as a rule, their sources in glaciers.² Tributaries generally come from valleys, such as the valley of Maryum-la. They may be swollen to a much greater volume than the source-river, as in the case of the great tributaries of the upper Satlej. Rains and melting snow may be responsible. Such a river will dwindle when there are no rains, whereas the river from a glacier will constantly run, except in winter. It is completely independent of the rains. Sunshine does even better service in melting the ice. The main river may be cut off periodically, if its water, as in the case of the Satlej, must supply one or two lakes.

The glacier is the result of the condensed humidity, which for a long time has been gathering on the mountains feeding the glacier. The mountains accumulate a store of solid water which it would take many years to melt and therefore a glacier would continue to feed its river even if every precipitation ceased for some time. The volume of water would only diminish. In fact the store of *nevée* is renewed every year. Therefore a glacier remains under all conditions a constant feeder of a river. It will only dwindle considerably in winter. From this point of view a spring may be regarded as more perennial. The source of the Indus is a spring. It is not likely that its uppermost tributaries come from glaciers. Thus the Indus is an exception among the three great Indian rivers which have their sources in Tibet.

From the point of view of comparative geography it may be of interest to remember the results to which Lord CURZON came on his journey on the Pamirs in 1894, one of his chief objects being to determine which of the several confluentes of the upper course of the Oxus was to be regarded as the true parent stream.³

Curzon crossed the Wakhlir Pass and proceeded to the very spot where, in his opinion, the Oxus has its source. He found the river issuing from two ice-caverns in a rushing stream. The snout of the glacier was 60—80 feet high. The source of the river was one great glacier, to which smaller glaciers contributed. In

¹ R. Strachey has also examined the motion of the glacier of the Pindar in Kumaon. He found the height of the snout to be 11,929 feet, whereas his two stations were at 12,140 and 12,946 feet. In the lower part, the glacier moved in 24 hours (in inches): 4.8 on the lateral moraines and 9.4 in the middle of the glacier; in the upper part resp. 5.3 and 10.0 inches. Journal Asiatic Society Bengal. Vol. XVII, part II. 1848, p. 203.

² In an article: »Physikalisch-geographische Schilderung von Hoch-Asien», Robert von Schlagintweit writes: »Von den Flüssen Hoch-Asiens ist vor allem zu bemerken, dass die Mehrzahl derselben ihren Ursprung nicht aus Quellen im strengsten Sinne des Wortes ableiten, sondern aus Gletschern.» Petermann's Mitteilungen 1865, p. 361 et seq.

³ »The Pamirs and the Source of the Oxus», Revised and reprinted from the Geographical Journal for July, August and Sept. 1896.

the case of the Brahmaputra I would say that the source is to be found in one great glacier and that the brooks from smaller glaciers contribute to the volume of the brook from the principal glacier.

One year later, or August 15th, 1895, I crossed the Wakhjir Pass, though I did not pay any special attention to the source; but as far as my observations went I agree completely with Curzon's opinion.¹

Curzon's examination of the different rivers which have been claimed as the source is extremely able and does not omit a single case. He says the little river joining at Bozai Gumbaz, which CAPUS regarded as one of the parent streams has not a single argument in its favour. The next claimant is the Pamir-river from Sor-kul or Victoria Lake, discovered by WOOD in 1838. Wood regarded it as the true parent stream of the Oxus, and Curzon shows that it has taken fifty years to rectify the mistake. Neither in length, volume, nor any of the requisite characteristics can it claim to be the parent stream.

The Bartang, Murghab or Aksu, which comes from the Chakmak Lake has been defended as the parent stream by VENIUKOFF, RAWLINSON and others, an opinion which has found favour with some who were unacquainted with the full geographical details. In favour of the Aksu it has been said that it is longer and has a greater volume than the Panja. The Russians give it a length of 252 miles from the Chakmak Lake to Kala Wamar, whereas the Panja from its source to the same point was roughly estimated at 240 miles. Curzon does not regard the length as a proof of a river being a parent river. And in this case he finds the length of Panja to be 270 miles.

Regarding the volume, Curzon's opinion should be compared with the method I have been following when examining whether the Maryum-chu or the Kubi-tsangpo should be regarded as the source of the Brahmaputra. Curzon says:² »it is obvious that the sole method of applying this test is . . . by measurement of the volume of the two streams at the point of junction. Not one of the advocates of the Aksu-Murghab theory, however, has ever visited Kala Wamar. NEV ELIAS had found, in November 1885, that the Panja was much more voluminous than the Aksu. Curzon also shows that the source of the Panja is situated at a higher elevation. Finally he points out that the historical proofs are not without weight. His words run: The final argument is that of historical authority and popular acceptance. In the first place, it is noteworthy that, from as far back as records extend, the identity of the river below Kala Wamar with the Panja (and not with the Murghab) above has been assumed by the inhabitants of the district, indicating that, in their opinion, this was the parent stream. Like the Greek Oxus, so the Persian name Panja is applied to the river both below and above Kala Wamar . . . Already in 1815 Lieut. MACARTNEY

¹ My observations on this journey have never been worked out or published. There is only a short account in popular form in *Through Asia*, Vol. II, p. 685. London 1898.

² Loc. cit. p. 36.

quotes a native informant who could mention even the glacier source, and Curzon submits that this native «was a better-informed and a more competent geographer than the host of big names who have succeeded him».

I have been led to quote this most interesting and valuable examination of Lord Curzon, partly to prove the important part played by glaciers when the question of head-rivers and tributaries should be considered, partly to remind of the difficulties and the many different considerations which may arise when the same question has to be settled. In the case of the Panja all the conditions speak in its favour. In the case of the Satlej, only the length and the historical opinion make the Tage-tsangpo the source. As to the Brahmaputra both length, volume and historical opinion agree to make the Kubi-tsangpo the source. For the Indus again the length and historical opinion are decisive. The great importance of the glacier sources, which was so clearly pointed out already by R. Strachey and in later years by Lord Curzon, is in full agreement with my own view and observations.

Vor. II



THE NYANDI-GOMPA



THE ROOF OF NYANDI-GOMPA WITH
THE KAILAS IN THE
BACKGROUND



THE KAILAS FROM N



THE KAILAS FROM THE TSEH-HA VALLEY.

A VIEW OF KAILAS FROM KHAME



VOL. II.



LOOKING EAST FROM KHALEF.

CHAPTER XXX.

THE SOURCE OF THE INDUS.

During September 1907 I travelled from Khaleb, a plain situated N.W. of Parka and at a height of 4,629m. (15,183 feet), to the source of the Indus.

From Khaleb the road proceeds to the N. 30° E. and winds over and between considerable heaps of old moraines before it enters the mouth of the Nyandi valley. The valley is narrow and deep-cut between the mountain sides of conglomerate and sandstone, often with perpendicular sides. Its bottom is full of gravel and blocks. It contains a little river, which, at midday, carried some 4cub.m. a second, near Nyandi-gompa, where a bridge is built. The pilgrims' road from Darchen or Tarchen follows the left bank. The landscape is very picturesque as the mountains have assumed fantastic forms like fortresses and towers, and sometimes the Kailas appears in the openings of gorges, narrow and deep as *canons*. At the foot of the living rock screes of detritus have frequently accumulated. The rise slowly increases, and here and there the river forms rapids. The volume of water gradually increases towards evening, to 7 or 8cub.m.

An important junction is called Dunglung-do; here, from N. 5° W., comes the valley of Dunglung, and from N. 70° W. the valley Chamo-lungchen with considerable snow-covered mountains in the background. From here and north-eastwards to the temple of Diri-pu the whole bottom of the valley is full of gravel and blocks of grey granite. At Diri-pu the height is 5,081m. (16,665 feet).

The river of the Nyandi valley is formed by several brooks from the north and west sides of the Kailas and from the meridional valley Tseti or Leh-lungpa, through which the road ascends to the water-parting between the Satlej and the Indus. The Tseti valley is cut through granite, gneiss-granite, and plagioclas-amphibolite. There is a good deal of gravel in the bottom of the valley, and mighty screes from the mountain sides, but there are also pasture grounds, and the road is far better than that of the Nyandi valley. In the background of a greater side-valley from the west, snowy mountains are seen not far away. Several tributary valleys open on both sides.

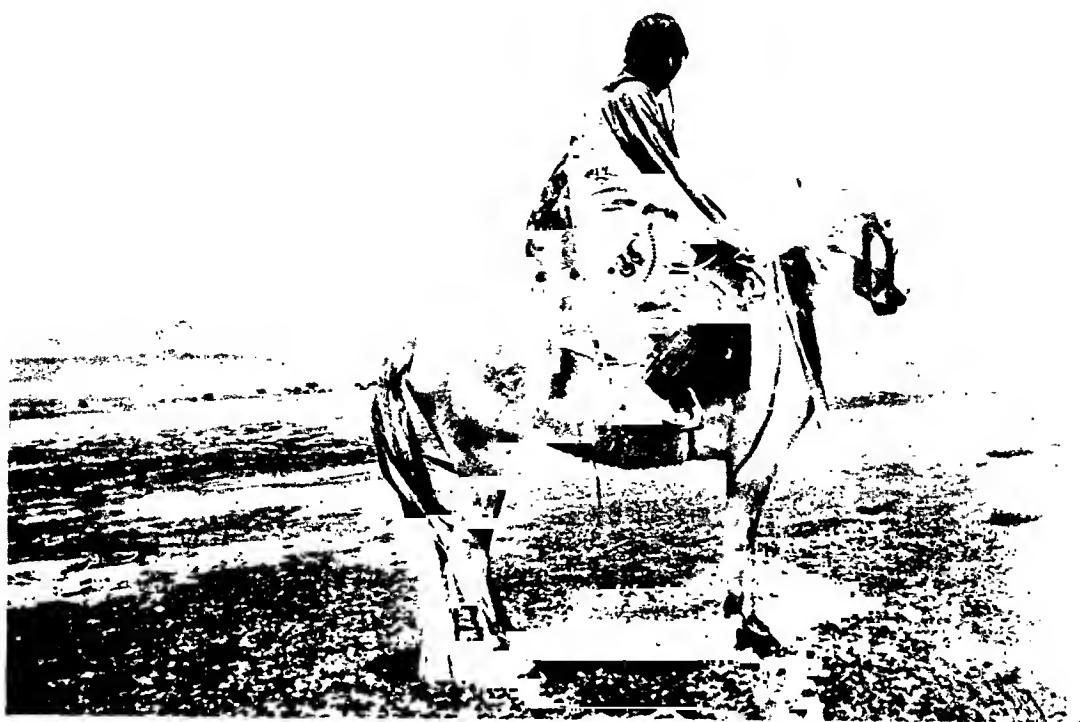
The higher one ascends the more dominating the Kailas appears. The rise becomes steeper, and amongst heaps of blocks the road goes up to Tseti-la, 5,628 m. (18,459 feet) high. The pass is like a platform between two low thresholds. The view does not reach far, as it is hidden by surrounding mountains. From the northern side of the pass a brook goes down to the N.W. and west, and probably joins the Dunglung-chu. Tseti-la is therefore only a secondary pass. The real water-parting pass between the Satlej and Indus is situated a little farther north on a flat threshold, called Tseti-lachen-la, 5,466m. (17,928 feet) in height.

On this pass there is an oblong pool which sends out a brook to the N.E., and is the source of the northgoing Tseti-chu, a left tributary to the uppermost Indus. The valley is broad, its bottom is covered with good grass, swamps, and moss: the brook has hardly 1cub.m. of water, which occasionally forms small rapids. Lower down, the bed is bordered by well marked though often interrupted erosion terraces. The mountains to the left side are low, those to the right more considerable. The breadth of the valley increases.

On the first half of the road granite prevails, after which quartz-porphyry becomes more frequent. Finally the Tseti-chu joins the Indus at right angles, at a place called Singi-buk, where the height is 5,079m. (16,659 feet). The Indus has here a left side terrace 7m. high, and sweeps close along the side of a mighty porphyry massive on its right side. Here the Indus carried only 4.5cub.m. a second in the afternoon, on September 9th. A right tributary joining the Indus a little below Singi-buk, is called Shinglung-ota. In its upper part is the pass Ngoma-chande-la with a road to an uninhabited region 2 or 3 days north called Tashi-toche. Four days down the river is a place Gechu-rap, which is probably the same as the Giachuruff of the Pundits.¹

Following the Indus eastwards through its comparatively broad valley one soon reaches the junction of the Indus with the Lungdep-chu, which, though it carried about 3cub.m and is thus much stronger than the Indus, is regarded, by the Tibetans as a tributary to the Singi-kamba. If the volume of water alone should decide which were to be regarded as the main river and which the tributary, the Lungdep-chu ought to be regarded as the source of the Indus. In the lowest part of its course this brook comes from S.40°E., but its source is said to be situated almost due south from the junction and at a distance of one short day's march. It comes from the same head range in which Tseti-lachen-la is situated; from the right or S.E. it receives several small tributaries. The mountains visible in its upper part seem to be comparatively low and to have very little snow on their northern sides.

¹ On the map, Pl. XV, Giachuruff has a height of 15,730 feet which must be at the river itself, for Giachuruff is a ford. Niacharphu, higher up the river, is given as at a height of 15,700 feet. I have 16,659 feet for Singi-buk. I could get no information of the Pundit's Jiachan. The distance between it and Singi-buk must be considerable as the difference in height is 300 meters, provided that the altitudes of the Pundit are reliable, which is doubtful.



A TIBETAN FROM THE PROVINCE OF CHOKCHU.



TSO-KAVALA ON THE NORTH-EASTERN SIDE OF THE KAILAS.



S.H.

THE KAILAS FROM S.W.



S.H.

THE KAILAS FROM S.E.



S.H.

THE KAILAS FROM N.



S.H.

THE KAILAS FROM N.E.

The Munjam-chu is the next tributary to the Singi-kamba; it also comes from the S.E. and is parallel to the Lungdep. It is said to have its source in a region called Jömö-membär; there is also a pass called Jömö-la, which the guide reported as situated N.N.E. of the Manasarovar. On the other side of Jömö-la one is said to descend to Aong-tsangpo. Not far from Jömö-la, somewhere between Tseti-lachen-la and Surnge-la, must therefore exist a triple water-parting, viz. between the Indus, Nganglaring-tso and the Satlej. From the Munjam junction only low mountains with very little snow are seen to the south and S.E. All the valleys in this part of the Transhimalaya, especially those directed northward from the water-parting, carry very little water. Farther east the north-going rivers are much stronger.

The rise of the main valley is extremely slow, hardly noticeable to the naked eye. Singi-yüra is a rock to the north with a curious effect of weathering, namely, a hole straight through. Singi-chava is a dominating though rather low peak south of the valley.

Above the Munjam junction the Indus has not more than $^1 \frac{1}{3}$ cub.m. of water left. The source of the Singi-kamba is situated at a short distance north of the road and at a height of 5,165m. (16,941 feet) at Camp 236. It is called, as often mentioned above, Singi-kabab, or the »Lion's Mouth». The water issues in the form of several small springs from below a terrace of white, porous limestone, falling 3° to the S. 10° E. Above this terrace the detritus scree rises immediately and very slowly to the foot of the mountains above. The springs are said to pour constantly, winter and summer; the water forms some small basins full of algae. The temperatures in different branches of these springs were 9.2, 9.5, 9.8 and 10.2° C. on September 10th.

At this point, the situation of which had been discussed and searched for during some 2000 years, the famous Singi-kamba or Indus is born. But the infant river, which is a mere brook, is much shorter than both the Lungdep and the Munjam. Continuing north-eastwards one still remains for a considerable distance within the drainage area of the Indus, for in fact and strictly hydrographically the Singi-kamba is only a right or northern tributary to the Bokar-tsangpo, which, itself, is only a very insignificant brook. Compared with the latter, both Lungdep and Munjam have a greater quantity of water and may be somewhat longer than the Bokar, though all of them are very short. From a hydrographical point of view it may be said to be a matter of taste which of these different brooks should be regarded as the principal source of the Indus. The question is of no great consequence, for, whichever branch should be chosen, its source is situated at a short day's march from Singi-kabab. The problem cannot be settled in any more satisfactory way than to accept the Tibetan view and regard the Singi-kabab as the source of the Indus, in spite of its being the shortest and one of the smallest of the several source branches. Any attempt to persuade the Tibetans that Singi-kabab were not the real source would fail, for it has tradition in its favour, it is a sacred place adorned with *mani* pyramids and prayer-stones, and it is one of the four famous *kababs*. And, after all, the Tibetans may perhaps be right even

from another point of view: the other tributaries become frozen in winter, but the springs of Singi-kabab flow the whole year round, a circumstance which is very much in favour of its volume of water.

From Singi-kabab, north-eastward, the valley becomes very broad, and open like a plain, where the road proceeds at some distance from the right bank of the Bokar-tsangpo; this river now contained a minimal brook partly frozen. To the S.E. the dark rounded mountains and hills are called Jungson. Yama-koto is a dominating massive in the same direction. From the N.W. and N.N.W. the considerable valley Shinglung-ngota enters; at its upper part rather high mountains are seen. At the foot of a little dark rock the Shinglung joins the Bokar-tsangpo, which is the greater of the two, although both are very small brooks. Jekung-ra is a camping-place at the N.W. mountain foot, and Jekung-tso is a minimal salt lake or rather a pool between hills and rocks close to the left of the road.

So far the ascent is extremely slow. The ground is hard, barren, and covered with fine gravel. Through a rocky gorge the road goes up to the little secondary threshold Jekung-la, 5,294m. (17,364 feet) high. At the S.E. foot of this pass the Bokar-tsangpo joins the Lamo-tsangpo; the Bokar valley seems to come from the east, and it is said to be nearly one day's march to its beginning in the Dukjunke-la pass; my guide could not give any information about the country east of this pass, but it is pretty certain that the eastward drainage goes to Aong-tsangpo and Nganglaring-tso.

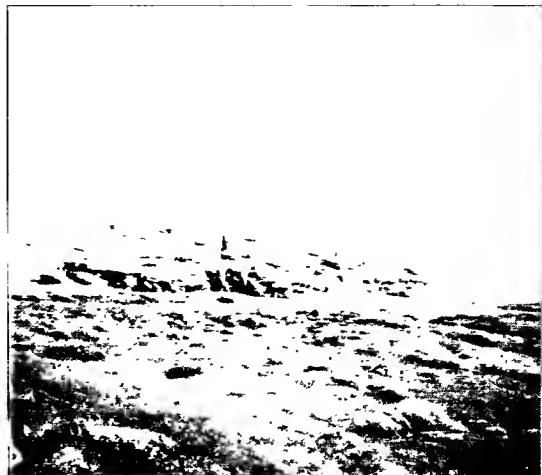
From Jekung-la the view reaches far to the south and S.W. where several flat ridges are seen covered with some snow and belonging to the range. On the other side of the pass the road comes in contact with the Lamo-chu, which has more water than the Bokar-tsangpo, though it is also a minimal brook. The valley is very flat, broad and open, surrounded by dark, violet, strongly weathered rocks; some grass grows along the brook. Shantse-gong is a hill to the N.W. A comparatively great valley enters from the S.E. with a brook, smaller than the Lamo-chu which comes from the N.N.W. From here the ascent goes up to Lamo-latse-la, 5,426m. (17,797 feet) high, which is the most important on the road to Yumba-matsen, as being situated on the waterparting between the Indian Ocean and a basin without outlet on the plateau-land.

The continuation north-eastwards will be described in another part (Vol. III) of this work. Suffice it to say here that the upper Indus flows between two fairly parallel ranges, though very irregular and interrupted. The range on the left side of the Indus contains the sources of the Munjam-tsangpo, Lungdep-chu and Tseti-chu and continues north-westwards, while the Bokar-tsangpo comes from the water-parting between the Indus and Aong-tsangpo. The range to the right side of the Indus is a part of the continental water-parting, and I crossed it twice; it is also to be described in Vol. III.¹

¹ In three days I accomplished the wandering on the pilgrims' road round Kang-rinpoche or Kailas. I have given a description of it in *Trans-Himalaya*, II, p. 189—203.



A "MANI-RIGMO NEAR THE SOURCE OF THE INDUS."



THE SOURCE OF THE INDUS.



ABANDONED CAMP AT THE UPPER INDUS.



THE ROAD TO THE SOURCE OF THE INDUS.



SOME OF MY SHEEP ON THE WAY TO THE SOURCE OF THE INDUS.



THE SAML.



THE VILLAGE LANGMAR IN THE VALLEY OF THE GARTANG OR GAROK RIVER



THE CONFLUENCE OF THE INDUS AND THE GARTANG.



MEASURING THE VOLUME OF WATER IN THE UPPER INDUS.



AT THE CONFLUENCE OF THE SINGI-KAMBA OR INDUS WITH THE GARLAND RIVER

CROSSING A BRANCH OF THE GARTANG, INDUS, ON THE ICE





The Isots below Tsim-Gang.

THE VALLEY OF THE INDUS AT DEMCHOK



THE TSANGPO AND ITS SOURCE

CHAPTER XXXI.

THE CATHOLIC MISSIONARIES ON THE UPPER TSANGPO.

It is surprising that DESIDERI, although he passed the Tsangpo several times and describes its course between Shigatse and Lhasa, as well as the bridges and boats, does not give any information about its upper course and its source. And still he was, together with FREYRE, the first European who ever passed by Maryum-la and thus came very near to the source. At any rate he could not call the Maryum-chu the source of the river as he does not mention the name of this pass. Nor has BELIGATTI, in his admirable description, anything to say of the origin of the Tsangpo. Father GEORGI, who gets his wisdom from Orazio Della Penna, Beligatti and other missionaries, has the following interesting passage, in which we partly recognise an old well-known story: »P. Horatius Pinnabillensis (della Penna) lacum describit in Provincia Tibetana *Ngari* ad confinia *Caskar*, ex quo testantur Indigenæ flumina quatuor exoriri, *Indum* nimirum, *Gangem*, & *Tzhang-pò*, sive *Tzhang-ciù*, aut etiam *Tsangià* dictum. Istud Lhassam rapidissimo cursu præterfluit: conjungitur cum *Cihasum* ad Arcem *Ciuciur*: mergitur post longa viarum intervalla in lacum Lopà; inde rursus emergit, seseque tandem in *Gangem* exonerat.»¹

It is obvious that Georgi, from the reports he had got of the missionaries, regarded the four great rivers: Gihon, Sihon, Indus and Ganges as originating either from »Caskar» or from its neighbour, the Tibetan province Ngari, for in a heading he says: »Origines fluviorum Gihonis, Sihonis, Indi, & Gangis in Caskar, sive in confinibus Provinciae Tibetanæ Ngari.»² And further: »Tzang-ciù fluvii scatebra eadem, quæ Gangis, & Indi,»³ where »scatebra» is the most verbal translation of the Tibetan *kabab*. Now as the Ganges is said to come from the lake in Ngari, the Tsangpo originates from the same lake, namely the Manasarovar. The information

¹ Alphabetum Tibetanum Romæ M D C C L X II, p. 343.

² Ibidem.

³ Ibidem.

was given by natives. It is said that the Tsangpo flows past Lhasa and, after some extraordinary adventures, joins the Ganges.

Another version of the old native legend is found at another place in *Alphabetum Tibetanum*:¹ »Saxa IV. ingentia juxta caudicem arboris originem præbent sacris IV. fluminibus: *Gangī*, *Sinthū*, *Pahkiù*, *Sita*. Primum quod Orientem respicit, caput præsefert Elephantis. II. Quod est ad Austrum formam *Bubalini* capitis. III. Equi viridis ad Occasum. IV. Leonis ad Boream», where the directions of the Satlej and the Tsangpo have been confounded.

ORAZIO DELLA PENNA has the following passage: »Per passare detto monte Kambalà si salisce certamente per un mezzo miglio, e poi si scende per cinque buoni miglia; d'indi si trova un fiume ben grande, che si chiama C'iasum, altrove però dicesi Tzam pò, o Tzangciù, che ha la sua sorgente in Ngari.»² Speaking of the rivers in Tibet, the Tsangpo amongst others, he adds: »Queste notizie si sono avute da persone ben pratiche, quali assolutamente affermane essere la sorgente del Gange dalla parte di Ngari verso la Tartaria.»³ By »Ganges» is always meant the Satlej.

He does not give us any detailed description of the very place in Ngari, from which these rivers should come. »Ngari», he says, »si divide in tre provincie, Ngari Sankar, Ngari Purang e Ngari Tamò.»⁴ From his description it is difficult to make out which particular part he means with Ngari Tamò. But when he says: »Ngari Tamò a ponente confina con Ngari Purang, a tramontana colla Tartaria, a levante colla provincia di Tzang, a mezzogiorno col Mogol», it can hardly be anything else than the country S.E. of the Manasarovar, where the Tamchok *par préférence* is situated and where we find the pass Tamlung-la. The confusion enters, when, at another place, he says that Tamò is north of Tzang.

In his great work on China, DU HALDE pays more attention to the question where the Tsangpo goes to than to its origin, and he arrives at the right conclusion — that it goes to the gulf of Bengal. He says that the Chinese call Tibet Tsan or Tsan-li from the name of the great river Tsan-pou. »La grande riviere qui traverse tout le Thibet, se nomme Yarou tsanpou ou Dsanpou», and he knows that although Tsanpou is the name given to every river in Tibet, it belongs specially to the Yarou tsanpou.⁵ As to the origin of the river he has only the following interesting passage: »Mais ils⁶ manquerent à un point essentiel, qui étoit de prendre hauteur auprès du mont Kentaisse, ou autrement Kan te chan, comme le

¹ P. 186.

² Breve Notizia del regno del Thibet, dal frà Francesco Orazio della Penna de Billi, 1730, — with notes by Klaproth. Nouveau Journal Asiatique, Tome XIV. Paris 1834, p. 177 et seq.

³ Ibidem p. 202.

⁴ Loc. cit. p. 183.

⁵ Description de l'Empire de la Chine et de la Tartarie Chinoise. Paris 1770. Vol. IV, p. 459 et seq.

⁶ The Lama surveyors.

nomment les Chinois, lesquels étendent ce nom à toute la chaîne de montagnes qui va à l'Occident; ou du moins dans le Pagode où ils s'arrêtèrent, pour s'informer du cours du Gange qui sort à l'Occident de cette montagne, tandis que le *Tsanpou*, qu'ils ont suivi & mesuré, vient à l'Orient vers *Lasa*.»¹ From this, one gets the impression that du Halde believed that the Ganges (i. e. Satlej) came from the Kentaisse, and that such is also the case with the Tsangpo, although the latter river takes the opposite direction, towards Lhasa.

This is the more curious as d'ANVILLE's maps from April 1733 are published in du Halde's work, and d'Anville's maps are, both regarding the source of the Satlej (his Ganges) and of the Tsangpo, and from a point of view of hydrographical truth, by far the best I have ever seen before Ryder's map. On these maps (Vol. I, Pl. LI, and Vol. III, Pl. I) the topographical detail is, of course, very wrong; I only refer to the hydrography. The Lama surveyors and d'Anville, who has been their cartographical interpreter to us, knew that the Tsangpo originates from the Himalayas in the south and that Maryum-chu is only one of its first tributaries. This is the chief point of the hydrographical problem. So, if we only pay our attention to the three rivers which constitute the upper Tsangpo, the Maryum-chu is *a priori* not to be taken into account. The Maryum-chu joins the Chema-yundung before it reaches the confluence with the Tsangpo. This is also clearly to be seen on d'Anville's map, although the river, which must be the Chema-yundung has no name there.

The principal river ought of course to be the one called Yarou Dsancpou or Tsanpou R. But here d'Anville must have misunderstood the information of the Lama surveyors or mixed up their observations. Or the Lamas must have made a topographical mistake, believing that the Chema-yundung, which they may have touched once in its lower course and once in its upper, was two different rivers. In its lower course they saw it was joined by the Maryum-chu, and in the upper that it was formed by several small source-branches from the southern mountains and particularly those parts of them which are situated immediately east of Lanchen-kabab. So they made this upper part of the real Chema-yundung join the Kubi-tsangpo far too high up. But the fact that the name Yarou Dsancpou has been placed along this mutilated Chema-yundung branch is certainly simply a slip of d'Anville's pen unless he had never heard that his MM. Tamtchouc or the Tibetan Tamchok-kabab or the 'source of the horse-river, was regarded by the natives and Chinese as the real source of the Brahmaputra.

On both d'Anville's maps M. Cocoun Kentchian is placed immediately near the MM. Tamtchouc, in such a way that the latter must be a part of the former, as it no doubt is in reality, both from Tibetan and Chinese points of view. Singi-kabab and Langchen-kabab are not greater mountains than Tamchok-kabab. This does not exclude the possibility of the existence of a mountain massive

¹ Op. cit. p. 465.

with the name Tamchok as d'Anville has it, although I never heard of any such mountain.

Therefore the obvious mistake on d'Anville's map consists in the fact that he has placed the name Yarou Dsancpou at the river which is in reality Chema-yundung, whereas its first tributary from the right or south, and which has no name on the map, comes from MM. Tamtchouc. This nameless river is in reality the Kubi-tsangpo or source of the Brahmaputra, coming from Tamchok-kabab. If d'Anville had only placed the name Yarou Dsancpou along this last-mentioned branch, his map would have been correct in this point.

After the publication of du Halde's work the knowledge of Europe regarding the upper Tsangpo cannot be said to have been improved by those who took interest in the problem. We have seen (Vol. I, Pl. LII) that Father TIEFFENTHALER made both the Satlej and the Brahmaputra issue direct from the Manasarovar. ANQUETIL DU PERRON is more careful as to its origin:

»Le pays d'Ascham est traversé par divers fleuves dont le principal est le Brehmapoutar, qui selon l'écrivain des faits arrivés sous Aurengzebe, a sa source dans la Chine septentrionale: mais il est plus probable qu'elle est dans le royaume de Tibet, vu qu'il y a un passage de ce fleuve à 4 journées de distance de Lassa, Capitale du Tibet, vers Neipál. Son cours est rapide, quoique son lit ait un demimille en largeur. De là il entre dans le pays d'Ascham, & force ses eaux par un espace resserré entre deux hautes montagnes. Son rivage est bordé par des forêts épaisse, le limon & la fange en rendent le trajet difficile. Son cours se dirige ensuite vers le Bengale; il passe à 2 milles de Rangamaty. Enfin il se mêle avec le Gange.¹

If he had had sufficient confidence in d'Anville's map, published fifty years earlier, he would not have founded his supposition on the passage of the river between Nepal and Lhasa only, for even above this passage d'Anville has twice entered on his map the name of the river and its course from the very source. It is amusing to see how simply he solves the intricate problem of the lower course of the river, which, later on, was to become the object of such interminable controversies.

Anquetil du Perron has a special chapter² with regard to STEWART's³ letter which confirms what he has said about the Tsangpo and Brahmaputra. He relates the events in 1774, which resulted in WARREN HASTINGS sending BOGLE to Tashi Lama. Stewart quotes du Halde's views of the Tsangpo »from its origin in the Cassimirian Mountains (probably from the same spring which gives rise to the Ganges) through the great valley of Thibet and his supposition that it reaches the Indian Sea somewhere in Pegu or Aracan. In the edition of du Halde, which I have at my disposal, he has treated the problem in a much clearer and more correct way

¹ Description historique et géographique de l'Inde etc. . . . publiée par M. Jean Bernouilli. Berlin 1786. Tome I, p. 468.

² Op. cit. Tome II, p. 460.

³ Account of the Kingdom of Thibet, in a letter from John Stewart Esqr. F. R. S. to Sir John Pringle, Bart. P. R. S.; from the Philosophical Transactions. Annual Register 1778. The letter is translated in Parraud et Billecoq: »Voyages au Thibet», Paris L'an IV, p. 73 et seq.

than Stewart represents it. I cannot find the passage in his work where he should have placed the source of the Brahmaputra in the mountains of Kashmir. And as to the final fate of the great river du Halde cannot be said simply to suppose that it reaches Aracan, for he is more careful and leaves a good deal of the question open. In fact he says: 'Mais où va se décharger le grand fleuve Tsan pou? C'est sur quoi on n'a rien de certain. Il est vraisemblable qu'il coule vers le Golphe de Bengale: car du moins on sait sûrement que des limites du Thibet il va Sud-Ouest à la mer, & que par conséquent il coule vers Aracan, où près de l'emboûchure du Gange dans le Mogol, que les Thibetains nomment Anonkek ou Anongen.'¹

Not only Stewart seems to have misunderstood du Halde, for Professor FABRI of Jena remarks, that Lhasa is situated on the river Barampoutre, which descends from the mountains of Cachemire, traverses the great valley of Tibet, takes its course towards Assam where it makes a sudden turn (and does not at all go to Pegu or Aracan as du Halde believes), crossing this country to the west, and, after having entered Bengal, joins the Ganges.²

Anquetil du Perron concludes: »Mais c'est toujours une satisfaction réelle pour moi, de me trouver d'accord sur ce point important de Géographie, l'identité du Tsanpou & du Brahmapoutren, réuni au Gange, &c., avec trois voyageurs instruits: MM. Bogle, Stewart & Rennell, lesquelles comme moi, ont résidé, dans le Bengale.³

Tieffenthaler had the problem clear to himself, for he says: »Von Nepal bis Lassa, die Haupstadt von Bütant oder Gross-Tibet, hat man 46 Tagereisen. Man geht über Berg und Thal und Wildströhme die mit Seilbrücken versehen sind; auch schiffet man über den grossen berühmten Fluss Brahmaputär, oder Sohn des Brahma, dessen östliches Ufer 4 Tagereisen von Lassa gen Nepal entfernt ist; er geht durch den Distrikt Ascham und fliesst zugleich mit dem Lakia, bey Rādām Rassùl, sechs Meilen östlich von Dacca in den Ganges.»⁴

I have quoted these passages about the mouth of the river only to prove that the old missionaries 140 years ago knew both the source and the mouth of the Brahmaputra much better than the learned geographers of later times. The Tsangpo-Brahmaputra problem was turned upside down by speculation.

¹ Description de l'Empire de la Chine etc. Tome IV, p. 471.

² Sammlung von Stadt-, Land- und Reisebeschreibungen, Tome I, Halle 1783.

³ Description historique et géographique de l'Inde etc. Tome II, p. 464.

⁴ Des Pater Joseph Tieffenthaler's historisch-geographische Beschreibung von Hindustan. Bd I, p. 306.

CHAPTER XXXII.

EUROPEAN SPECULATION UP TO THE MIDDLE OF THE LAST CENTURY.

Now we come to the epoch of confusion introduced by Europeans into the clear and correct hydrography given by the orientals.

FRANCIS HAMILTON had not the slightest doubt about the Brahmaputra of Assam being the same river as the Tsangpo of Tibet. He does not even call the river Tsangpo, but uses the name Brahmaputra the whole way up. And he has heard that borax and salt are brought from a lake situated almost north of Katmandu, about fifteen days journey beyond the Brahmaputra, by which lake the Tabie-tsaka may have been meant. But he is wise enough not to say anything about the source of the Brahmaputra.¹

In LLOYD's and GERARD's book the situation of the source is not given in any precise way, but in its general form it is correct: The Brahmapootur is named Tamjoo Khampa, or Erechoomboo, and one of its streams takes its rise to the south-east of Mansarowar.² Indeed two of its streams take their rise S.E. of the lake: Chema-yundung and Kubi-tsangpo.

At another place³ Gerard relates that the upper Brahmaputra is said to be greater than the Indus and is called Tamjoo, Damchoo,⁴ or Erechumboo. One stream, which is reckoned the principal, rises S.E. of Mansurowur, and there are others from the eastward; this agrees very well with the accounts of the Lamas, who describe the Brahmapootra as issuing from the eastern side of Mont Kentaise . . .

¹ An account of the Kingdom of Nepal. Edinburgh 1819, p. 214. The only allusion he has to the source is when he speaks of the large kind of sheep, »which seem to be the common beasts of burthen in all the countries towards the sources of the Indus, Ganges, and Brahmaputra». So, at any rate, he must have suspected that the sources of the Brahmaputra were situated in the same country as those of the Indus and the Ganges. On his map he makes the river begin far to the east of the Manasarovar. Vide Pl. V.

² Narrative of a Journey etc. by Sir W. Lloyd and Capt. Alex. Gerard's account of an attempt etc. . . . London 1840. Vol. II, p. 186.

³ Account of Koonawur in the Himalaya etc. London 1841, p. 134.

⁴ Compare Dam-chu, »Trans-Himalaya», I, p. 417.

they make the Brahmapootra rise S.E. of Conghe Lake, which the Koonawurees call Koongeoo or Goongeoo; there must, however, be many heads to this river; so I look upon the accounts of the Lamas as pretty correct. Gerard corroborates the accounts received by Mr. FRASER regarding the Indus and Brahmaputra; the name of the ridge whence the eastern branch of the latter issues, is called (by Gerard's informants) Murgeoolma, which is said to be a prolongation of Kylas. He further adds: Tieffenthaler says the Sanpoo or Brahmapootra, issues from Mansurowur, which accords with the western branch; and I may here add, that the natives, speaking generally, say the sources of the above three rivers and also of the Gogra, are at Mansurowur; by which nothing more is meant than in the vicinity of that place. The direct road from Mapang to Lahassa, situate fifty days journey to the S.E., lies along the bank of the Tamjoo, which is here called Erechumboo, and is said to be almost plain and practicable by horsemen at full speed in most places.

This description is rather good as being based only on information. For indeed the principal stream, Kubi-tsangpo, rises S.E. of the Manasarovar, and there are other feeders from the country east of the Manasarovar: Chema-yundung and Maryum-chu. The eastern branch of the Brahmaputra, the Maryum-chu, was said to rise from Murgeoolma, i. e. Maryum-la. He says his information agrees with the accounts of the Lamas who made the Brahmaputra start from the Kailas. And, for the western(?) branch it agrees with Tieffenthaler, who made the river start from the Manasarovar. Then he adds: the natives say the rivers begin from the Manasarovar, by which they mean the vicinity of the place. But as a matter of fact the Lamas have not made a single one of the sources of the Tsangpo rise from the Kailas; Tieffenthaler's view does not accord with any real fact, and as far as the present natives are concerned, I never heard them say that any other river than the Satlej issued from the lake. In the essential point Gerard is right, namely, that several streams feed the upper Tsangpo and that the principal of them is S.E. of the lake.

RITTER is quite sure that the Tsangpo is the same river as the Brahmaputra.¹

Ritter's opinion is only an extract from all that was known in his days, and he has chiefly used the missionaries and Chinese authors. He, of course, finds the truth, saying the great Tsangpo, otherwise called Tamja Kampa or Tamjok, has its source in the animal mountain Tamtsiogh, in which we find a new proof that d'Anville, only by mistake, placed the name Yarou Tsanpou at the Chema-yundung

¹ Die Erdkunde von Asien, Band III, Berlin 1834, p. 214. Speaking of the western parts of Himalaya and Transhimalaya Ritter says: »Zwischen diesen Nord- und Süd-Ketten, im äussersten westlichen Dzang, hat nun in jenem Tier-Berge (Tamtsiogh u. s. w.) der Yaru Dzang bo tsiu, das ist der grosse Strom Dzang bo, der Hauptstrom von Tübet seine Quelle; er stromt von da gegen O und SO durch ganz Tübet. Dies ist derselbe grosse Fluss, der von den Anwohnern der Westseite des Kailasa, an den heiligen Doppel-Seen, den Namen Tamja Kampa erhielt, welcher durch Ussang (d. i. Oui-Tsang, oder Wei-Dzang, Ober-Tübet) strömt, derselbe welcher von andern Tamjok genannt wurde.» Op. cit. p. 219.

and not at the Kubi-tsangpo, which, otherwise, on his map correctly comes from the mountain with a horse's head.

HENRY STRACHEY also used the opportunity he had to get some information about the source of the Tsangpo, and what he found is this: Immediately east of the mountains which bound that side of Cho Mápan near the Sámo-tokchim Tarjum, in the district of Hor Tol, rises a stream, Chima-Yungdung, so named from the profusion of the sand, 'Chima', which covers the ground about, probably the same granitic debris that spreads for miles around the base of Momonangli. This river flows eastward past Digarcha and Lhássa, and informants recognize the name of Bráhmapútra, as applied to it by the Hindus of Nipál; or pretend to do so, for I am not sure that the Nipalese do identify the river as the Bráhmapútra. — Chima Yundung is the local name of the sandy ground, in which the last river rises: it is said to originate in springs. East of its source in Hor Tal, this river takes the name of Eru-Zhungbu . . .¹

Enumerating, in the same article, the animal sources of the four rivers: Indus, Satlej, Karnali and Brahmaputra, Henry Strachey says, that the Brahmaputra, or Tamjyak Kamba, originates «from the Horse». The horse is Tamchok-kabab. But, from his informants, he gives the name Chima Yundung to the sandy ground »in which the last river (Brahmaputra) rises«. Here the confusion comes in: The Tamchok-kamba rising from a place called Chema-yundung. Where then is Tamchok-kabab or the source of the Horse river situated? Chema-yundung may easily be the name of a sandy region, but the river that flows through it is not Tamchok-kamba but Chema-yundung. And the source of this river is a glacier, or perhaps several glaciers in the mountains called Chema-yundung-pu. In this particular point even the vague hydrography of KAWAGUCHI is better than Henry Strachey's. It is not surprising that Strachey's informant knew only the Chema-yundung and consequently believed that it was the source of the great Tsangpo. For the ordinary road over Tamlung-la touches Chema-yundung but not at all the principal river, which is Kubi-tsangpo. The nomads prefer the grass of the Chema-yundung which is more abundant and easier to get at. And there may, perhaps, be Tibetans, who really regard the Chema-yundung as the source of the Tsangpo, in which case, however, the Tamchok-kabab would have to be placed at Chema-yundung-pu, which is not the case.

Sir ALEXANDER CUNNINGHAM who visited Ladak in 1846 and 1847, has, naturally enough, had no occasion to contribute to the knowledge of the source of the river. All he says is that the Brahmaputra's source is situated »on the eastern face of the Kailas mountain«,² which proves, either that he did not know, or did not

¹ Narrative of a Journey to Cho Lagan (Rákás Tal), Cho Mapan (Máñasarówar), and the valley of Pruang in Gnari, Húndés, in September and October 1846. Journal As. Soc. Bengal. Vol. XVII, Part II 1848, p. 327, 330.

² Ladák etc., with notices of the surrounding countries. London 1854, p. 158.

care for the more reliable information Strachey had obtained much further east, and which was published six years before Cunningham's book.

Sir RICHARD STRACHEY's contribution to the problem runs as follows: Regarding the source of the Bráhmaputra we have no real information. It appears, however, most probable that a strip of Tibet, 20 or 30 miles broad, along the northern face of the watershed, drains through the Himálaya into the Ganges, as far eastward, at least, as the meridian of Calcutta, and possibly farther; and that the Sánpur Tachok-Tsangpu (Tibetan), which must surely be the Bráhmaputra, rises to the N. of this belt in a manner similar to the Indus. We cannot, therefore, say with any great degree of probability that the source of the Bráhmaputra is to be found in the immediate vicinity of the lake Mánasarowar, but indeed rather the reverse; though it is not unlikely that the drainage of the N.E. face of the E. portion of the Kailás range may fall into the Sánpu.¹

He openly says that nothing is really known. He correctly finds it most probable that the source is rather far from the lake, and is wrong in suggesting that the river should get some water from the N.E. side of the Kailas. The comparison with the Indus is not quite clear. If he alludes to the Sanskar branch and means that the Tsangpo gets most of its water from ranges farther south, he is correct, for indeed the precipitation of the S.W. monsoon is diminishing towards the N.E.

Another version is given by Dr. GUTZLAFF: 'The Yarou-Dsangbo (the clear river of the West) is one of the largest in Asia, traversing Tibet, and running through 14° of longitude. Its source is near the Mapama lake, where other great rivers of Asia take their rise, in about 30° N. lat. and the 77° E. long., on the frontiers of Ari, at the Tsamtserg mountain. This is not far from a lofty peak, named by the Hindoos, Oneuta, and considered by them to be the highest in the world. It stands in connection with four other mountains, which take the names of Horse, Elephant, Lion, and Peacock, and extend 48 geographical miles to the high chain of Ari . . . The Dsangbo here receives many tributaries from the N. (such as the Esunshia, Somia, Archoo, and the Navuk-Dsangbo). Several others join it from the S., running down from the Himalaya mountains, and swelling its course through a fertile broad valley.'²

It is easy in this description to recognise d'Anville's map. The source of the Yarou-Dsangbo is placed at a mountain called Tsamtserg, — Tamchok and amongst the northern tributaries we recognise the Archoo and Navuk-Dsangbo, improved from Artchou and Naouc Tsanpou. The Esunshia and Somia are obviously d'Anville's Kianskia Somia R.

On a beautiful map of India, from 1827,³ where the lakes and their surroundings are still taken from Moorcroft, we also find a representation of the 'Supposed

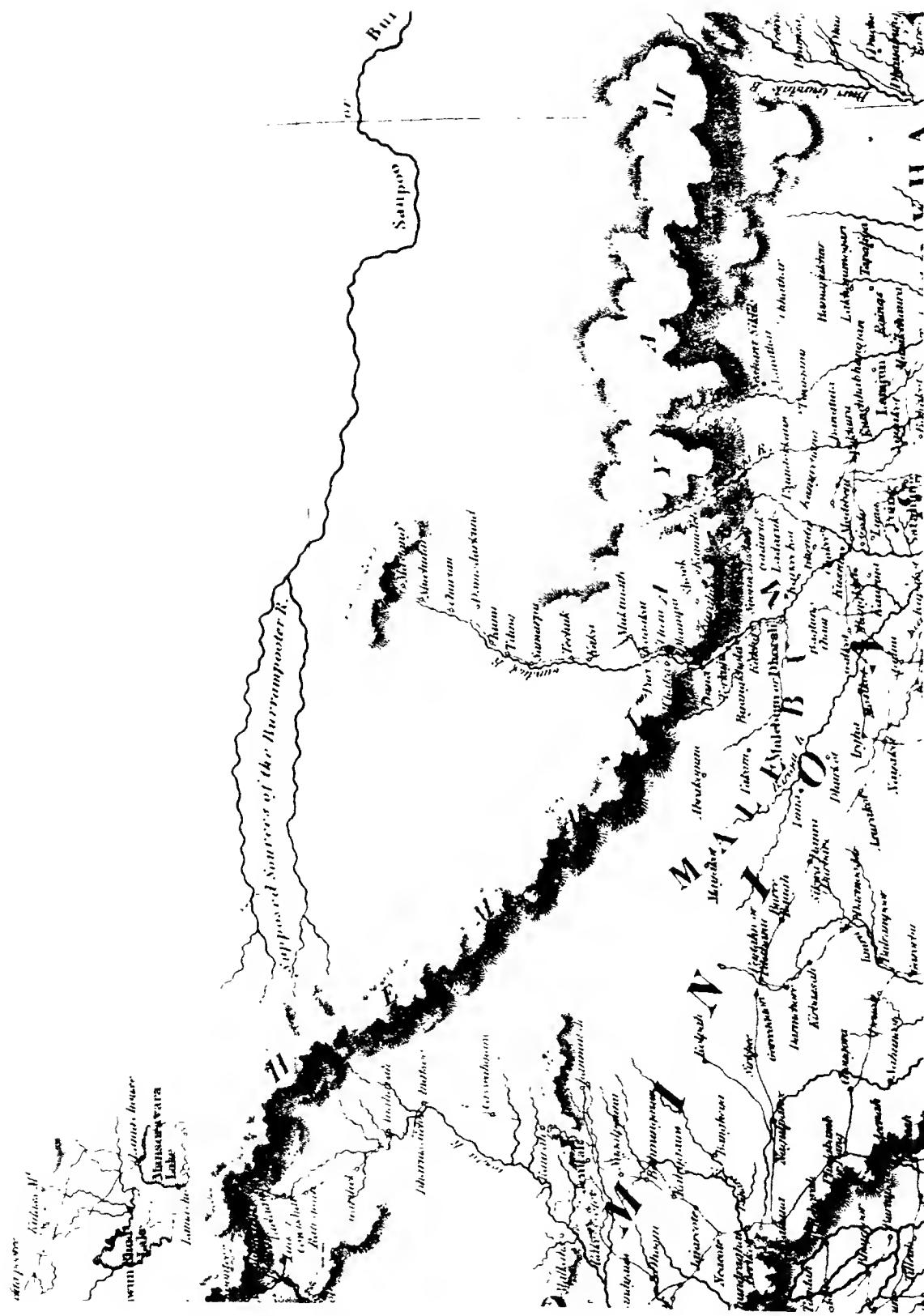
¹ Journal Royal Geogr. Society, Vol. 21, 1851, p. 64.

² Journal Royal Geogr. Society, Vol. 20, 1851, p. 198.

³ Map of India from the Latest Surveys of the best Authorities. Published principally for the use of the officers of the Army in India . . . by Kingsbury, Parbury & Allen. London 1825, Drawn & engraved by John Walker. Additions to Sept. 1827.

Sources of the Burrampooter R., Pl. XVI, where the river is correctly shown as taking its rise from the northern slopes of the Himalaya; it has two parallel source-branches, each with two heads; lower down, the river is called Sanpoo. This map has not taken the least impression from d'Anville, and therefore lacks all the good qualities of the latter.

Of all the Europeans I have mentioned in this chapter not one had ever seen any part of the Tsangpo, but all of them have something to tell the world about its source. Therefore the source of the Brahmaputra has been wandering about in the most restless way. Sometimes it has been on the slopes of the Kailas, sometimes in the sacred lake and sometimes near or far from the Manasarovar. The only one who found the right course was Carl Ritter, because he used the oriental authors. All the rest have only complicated the problem and given an excellent illustration to the fact that geographical discoveries are seldom made at home. The orientals had been to the source of the river and therefore their description was right, as I have shown in the chapters of Vol. I dealing with the Chinese geographers.



The Source of the Brahmaputra as shown on the map of Kingsbury, Parbury & Allen, in 1827.

CHAPTER XXXIII.

THOMAS W. WEBBER.

In June 1864, THOMAS W. WEBBER together with three of his countrymen made a trip to the higher valleys and across the snowy range.¹ They went up the Kali river and then into a considerable valley in Nepal, east of the Kali and camped at a torrent from the lofty peak of Api, after which they crossed the Tinkar Pass, nearly 18,000 feet. Webber gives a graphic description of the morphological difference between the land they had left to the south and the land stretching before them to the north: a level plateau-land after deep-cut valleys, hillsides without a bush or a blade of grass instead of rich forests and vegetation south, a country with a snow-line of 19,000 to 20,000 feet, after the rivers and torrents of the south. To the north there was not a tree in a thousand miles, or perhaps ten thousand (!). — North-east was a glorious peaked snow mountain, with four subsidiary peaks showing against the sky. This was the never explored Gurla Mandhata, 25,500 feet high, where the snow line only commences at about 19,000 feet elevation. In front of them was Taklakar.

They had some difficulty in crossing the Koriali river, *Source of Gogra River* as it is called on the map. After some dispute the *Zung-pun* agreed to let them go for a month's trip N.E., provided they promised not to go near the Manasarovar. The unknown country then lay open before them. Colonel SMYTH had never been able to go there and Mr. DRUMMOND had not reached it on his previous trip. It was, therefore, indeed a *terra incognita*. From Taklakar they decided to strike in a N.E. direction, although it is direct east on the map. They were informed that there was a pass over the great range which we could see in that direction, across the eastern shoulder of Gurla Mandhata, which would bring us out on to the countries east of Manasarowar, where were extensive jungles, frequented by few natives and famous as the haunt of the rarest of all animals, the *bos grunniens*. Colonel Smyth had on previous expeditions been told that across the second range the country was

¹ *The Forests of Upper India*, London 1902, p. 74 et seq.

wild and dangerous. By the second range probably Gurla and its eastern continuation is meant.

As they had to avoid the Manasarovar they decided to take the Dak Eo pass, which was supposed to save them about ten marches,—of course very much exaggerated. They reached the pass, «a ghat or passage between high walls of black basaltic rock, a veritable gate of death». Its height was close on 20,000 feet — in the text; on the map it is only 19,000.

Here they suddenly saw an extraordinary lake, black as pitch and with floating islands and glistening icebergs. The rocks trembled under their feet, terror seized them, there was a cracking and a roar, the lake seemed to rise and surge up to where they stood and the iceberg to sink into the watery depths below! The travellers themselves even forgot from which side they had mounted, but fortunately they heard the shouts of men from far below, so they hurried down from rock to rock, as if the devil were behind.

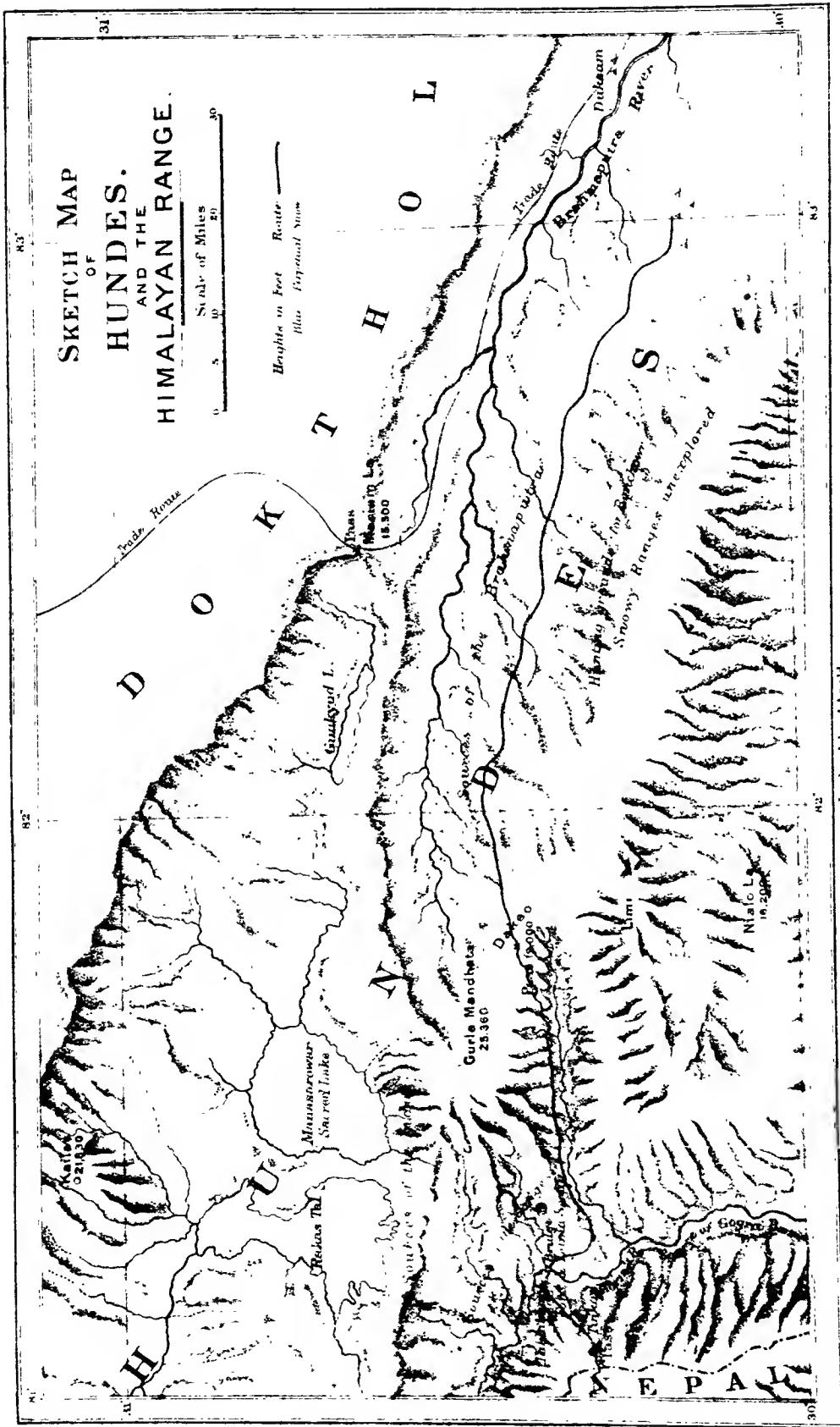
It is a pity that the wonderful lake is not entered on the map Pl. XVII. It is obviously a small moraine lake and the icebergs must have come from the snout of a glacier. Can this lake possibly be situated at the source of the Chema-yundung? For at least one Chinese text mentions such a lake. But if it is situated at the foot of the Dak Eo pass, it can only be at about 22 miles from the highest peak of Gurla, whereas the source lake of Chema-yundung, if such a thing exists, must be at about 43 miles distance from the Gurla. Every lake 22 miles, nay even 37 miles east of Gurla must belong to the Manasarovar and Satlej system and not to the Brahmaputra.

On account of the considerable elevation of the snow line and the dryness of the climate he thinks it likely that an ascent of the Gurla Mandhata would be successful.

However, they descended from the Dak Eo pass (19,000 feet) and in the camp at its northern foot they were still at a height of 19,000 feet, so the descent must have been very gradual, which is surprising in these gigantic mountains, belonging to the highest in the world.

We had now come out on the watershed of the Brahmaputra, having crossed the range which lies to the north of the Himalayas. Descending rapidly to the northward we found wide valleys and grassy flats opening out, and all the streams trending towards the east. Jussoo informed us that they flowed into a great river which ran towards Lhasa, and that now we were in a vast and unfrequented jungle or wild country, the home of the wild yak . . .» If they had known d'Anville's maps, they would never have needed to ask Jussoo.

From this description it is, however, obvious that they crossed the watershed of the Karnali. They went from Taklakar 18 miles + 12 miles + a long and trying march of 16 hours», and immediately on the other side of the watershed they reached streams running into the Brahmaputra. In this respect the map agrees with



Webber's map of the Source of the Brahmaputra, 1864 (1902).

the text. But both disagree with the reality. For, provided the Dak Eo is situated only some 14 miles E.S.E. of Gurla's highest summit, as on Webber's map, they could not possibly have reached the upper feeders of the Brahmaputra without having crossed at least the Tage-tsangpo, or the glacier brook from Ganglung-gangri. Such a fact might have been omitted in the text, but why should it be omitted on the map, where their route from the Dak Eo goes directly down to the sources of the Brahmaputra?

However, they are now somewhere in the upper reaches of the Brahmaputra. There were no inhabitants, the valleys were desolate, »there was ridge succeeding ridge, and sloping valleys intervening, all so like one another that it was hard to distinguish one's locality. The compass had often to be consulted if the great summit of Gurla Mandhata was lost to view, and our shikaris were often in doubt as to our direction . . . Near the source of the river the Gurla cannot be seen at all!

Webber has another surprising piece of news in store for his readers. For at one occasion he and his party suddenly found themselves on the watershed of the Indus!¹ Far beneath them and only some miles away was the Manasarovar. Towering above all the mountains they saw the sacred Kailas. They sat down for a while to enjoy the wonderful and extensive panorama, and sketched it in water colours as a record of our tramp.

In connection with the source of the Satlej and the Indus I have tried to solve this problem. Wherever you choose to place the source of the Brahmaputra,— and there have indeed been many proposals in that way — the Kailas cannot be seen from anyone of them, at any rate not from anyone of the sources of the southern branches. I do not know whether it can be seen from the Maryum-la. But the Manasarovar cannot be seen from the Maryum-la. RYDER and RAWLING crossed the Maryum-la on November 26th and: »came in sight of the Manasarowar lake on November 30 .² From the neighbourhood of none of the southern sources can the lake be seen. It is invisible from the whole region of the uppermost Tsangpo. And still Webber saw it beneath him and only some miles away. And as a record of his tramp he sketched the whole panorama with the lake, the Kailas and all. Moreover, between the shore of the Manasarovar and his own standing point the foreground was flat, rolling hills and ridges sloping gradually towards the lake . . .» Such a description of the foreground, and S.E. of the lake is correct, but only at a distance of some miles from the lake.

Next day (after having sketched the Manasarovar etc.) we marched a long way eastward along the northern slopes of the Gurla range, following the valley of the Brahmaputra.³ They marched along the Gurla range and in the valley of the Brahmaputra at the same time! From any point from which the Manasarovar and

¹ Op. cit. p. 126.

² Ryder. loc. cit. Geographical Journal Vol. XXVI. p. 387.

³ Op. cit. p. 127.

the Kailas can be sketched to the very beginning of the Brahmaputra valley it is at least 70 miles. This is indeed a long way for one day's march. And previously, from Taklakar to beyond the watershed they had needed three days for a distance of 45 miles,¹ of which one is said to have been a long and trying march of 15 hours. But in the meantime, they were hunting wild yaks in the side valleys, which seems to have occupied all their attention for two or three days. There are no dates, no distances, no directions, no altitudes, no co-ordinates, no camps, so the reader is completely lost, as when endeavouring to decipher Andrade, Benedict Goës or Grueber and Dorville.

But still they were hunting yaks in the valleys of the range running eastward of Gurla Mandhata». And there is a very fine peak called Limi belonging to this range, where some great glaciers exist at the heads of the valleys which debouch into the river flowing towards the east. On the map, Limi is situated south of the Gurla range, and supposing our yak-hunters were opposite to Limi on the northern side of the watershed, and supposing Limi is, as on Webber's map, S.S.E. of the eastern corner of the Manasarovar, the travellers must even here have been some 10 or 12 miles *west of the source of the Satlej*.

Regarding the northern valley of the range running eastward of Gurla-madata he says:² All these valleys were of a totally distinct character from the precipitous gorges and cañons on the Himalayan side. The climate was almost rainless, and there were no deep valleys cut out by torrents; only rounded ridges with flats lying between, and the streams were few and small, depending almost entirely on the melting of the snow. The country further to the east and north opened out into wide plains, sloping gradually to the river Tsampu, which flows eastward. Here were the sources of the great Brahmaputra, originating from the glaciers of Gurla . . . We could see at times the camping-ground of Duksam, where were some tents of the traders, who had yaks, ponies, and many pack-sheep.

If no other European had ever been in this part of the country one would have to accept this short and vague description as gospel. But now we possess very good maps and are able to control all the geographical statements given. The passage quoted above is incredible. There were no deep valleys cut out by torrents. In reality the southern tributaries to the uppermost Tsangpo are a succession of deep valleys with rivers. There were only rounded ridges with flats between the valleys. In reality there are very marked rocky ridges, which would be rather difficult to cross. The streams were few and small. In reality they are many, and several of them considerable, one even impossible, or at any rate, very difficult to cross during the summer. The streams were almost entirely dependent upon the melting of the snow. In reality they receive by far the greatest amount of their water from glaciers. The country to the north is said to open out into wide plains. In reality the un-

¹ On Webber's map, but in reality hardly more than 30.

² Op. cit. p. 128.

interrupted chain of Transhimalaya rises in the north. Further we have the statement that the great Brahmaputra originates from the glaciers of Gurla. This statement was published in England 170 years after the publication of d'Anville's map and 75 years after Klaproth's translation of the Chinese geographers' description of the source of the Tsangpo, both nearly correct.

And finally we are told that the travellers at times could see Tuksum. From the place where the Manasarovar was visible to Tuksum is about 110 miles. On Webber's map Tuksum is one mile from the northern bank of the Tsangpo, in reality it is 9 miles. The place from which they returned, was, on the map, 11 miles from the Tsangpo, so that from a distance of 20 miles they could see yaks, ponies and pack-sheep. But the most marvellous thing is that, on the whole way from Dak Eo till they came opposite Tuksum, they only crossed two »small streams». It is physically impossible to travel north of the water-parting towards the east, from a point situated where Webber's Dak Eo is marked out, without crossing the Ganglung-chu, the Angsi-chu, the Chema-yundung, the Kubi-tsangpo and four other rivers, of which the last, before Tuksum, is Gyang-chu, or Kyang-chu. Of these, as I said before, the Kubi-tsangpo, which is the very Brahmaputra, can hardly be crossed at all, so high up as indicated on Webber's map. The whole of Webber's route is, on his map, on an average 8 or 10 miles from his »Brahmaputra River«, and where it is nearest it is still 6 miles from the river. The river cannot be seen at such a great distance. In open country it could, but in these parts the hills and ridges hide the bed of the river.

Webber's map has six sources of the Brahmaputra. The four first of them, which ought to be the most considerable of all, begin *below* his route. He must therefore have travelled above all the tremendous glaciers that feed them. But he marched some 12 miles north of the crest. The puzzle cannot be explained by ordinary physical laws.

The Maryam La is on the map. And so is a river which represents Maryum-chu. As we know, the Maryum-chu joins the Chema-yundung which is a tributary to Kubi-tsangpo. On Webber's map the Maryum-chu joins the main river and below the junction there is no sign of Kubi-tsangpo. Farther down there are some three other tributaries which he did not cross at all, although he was a long way north of the southern watershed.

Colonel Smyth and Mr. Drummond «explored a considerable extent of country». Smyth marched »east and northward over the Marian La«. But where are the results and the documents which should beat Nain Sing's pretended record two years later?

Then they returned westward by long and rapid marches, crossed Dak Eo and reached Taklakar. At the end of Chapter XI we are again told that the Brahmaputra, as also the Ganges and Indus, rise from the glaciers of Gurla. Of course, if we call the whole range the Ganglung-gangri, the Kubi-gangri etc., Gurla or the Gurla range, the Brahmaputra begins from Gurla. But both in the text and on the map

Webber places the source of the river on the very Gurla-mandata itself! It is an irony of fate that the real source of the river is, if transferred to Webber's map, situated where he has the legend: Snowy Ranges unexplored.»

The only parts of Webber's map which are correct, as for instance the lakes and Samo-tsangpo, are taken from the Stracheys and Nain Sing. Even the upper course of the Brahmaputra has a striking likeness with Nain Sing's representation, although Nain Sing must be excused, for he never travelled along this part of the river. He has three southern tributaries which are just as short and insignificant as Webber's. In some respects Nain Sing's map is much better, although he never saw the river. Another feature on Webber's map seems also to be taken direct from Nain Sing, namely, the range stretching N.E. from Gurla, which on Nain Sing's map is drawn much darker and stronger than even the Transhimalaya,— though it does not at all exist. It is hard to believe that two travellers should sketch at the same place a range which does not exist in reality.

The red route itself makes extraordinary undulations which do not agree with the relief and configuration of the ground. One gets the impression that no map was made and no diary kept and that the whole trip was put together from memory, which had weakened during 40 years. If Webber, by Chapter XI in his book: *Gurla Mandhata and the sources of the Brahmaputra* has proved anything, it is that he has never been at the source of that river. The first he sees after having crossed the watershed is that all the streams trend towards the east, and all the ridges slope towards the Manasarovar! And still Webber's book is written in such a charming and sympathetic style that one easily forgives him that his discoveries go straight against both physical and geographical laws. As a sporting trip, his and his comrades' journey was clever, courageous and admirable. As geographical research it does not satisfy even the most modest modern demands. The fact is, as I have proved above, that Webber never had the faintest idea where the source or sources were situated. But so far as one can trust his fantastical map, it is true that no European had ever been so near the Tamchok-kabab as he.

This trip took place in June 1864. Later on the same summer they again went up the Kali river with the intention of crossing by the Kuti pass into Tibet. On the north side of the watershed they followed the Duryumtti (Darma-yankti of Strachey) river, »a source of the Satlej», and came to Gyanima. Two marches brought them to a deep valley called Jaidam. »No sahib had ever been here before.» On the way back over the Dhura passes, they followed the same route as the Stracheys and Winterbottom in 1846 and 1848. He mentions the deep ravines to the north of the Milam ghat and says they had been formed by the head waters of the Satlej.

CHAPTER XXXIV.

NAIN SING.

In this chapter I shall first quote some important passages from MONTGOMERIE's analysis of NAIN SING's classical exploration along almost the whole of the Tsangpo from the neighbourhood of Lhasa and up to Maryum-la.¹

»The Pundit on his return said that the river is called by the Nari and Ladak people the Tamjan Khamba (the horse's mouth), from its source to the junction of the Charta Sangpo, from the latter to Janglache it is called Machang Sangpo by the Dokthal people, and from Janglache to Lhasa it is called the Narichu Sangpo by the Lhasa people, the latter name being given to it because the river runs from near Nari, the country about the Mansarowar etc.. Everywhere he heard that it went down to Hindostan.

»The river Brahmaputra was ascertained to rise in about north latitude $30^{\circ} 2$, and east longitude 82° (Pl. XIII). — The great road along which the route-survey was carried does not follow the course of the river for the first 50 miles, but the road was probably never much more than 10 miles north of the river. The general direction of the river's course during the first 50 miles was, however, quite unmistakable, owing to the gigantic range visible to the south of it, the large glaciers which filled every ravine of that range evidently forming the sources of the river.»

In this, both Nain Sing and Montgomerie were correct, for the Maryum-chu, along which the great road runs, is only a tributary and the sources are in the glaciers of the Kubi-gangri, which was visible to the south.

»The Tamjan Tarjum, in latitude $30^{\circ} 21'$, longitude $82^{\circ} 51'$, was the first point of the road actually on the river. The staging-house is called Tamjan, from the

¹ »Memorandum on 600 miles of the Brahmaputra River, from its source near the Mansarowar Lake, in latitude $30^{\circ} \frac{1}{2}$ and longitude 82° , to the junction of the Lhasa River . . .» Journal Royal Geogr. Society, Vol. 38. 1868, p. 211 et seq.

Tibetan name of the river, which is Tamjan Khamba (horse's mouth). From Tamjan there was a good view up the river for a considerable distance. The Tibetans all agreed in saying that it was the main branch of the river.»

The river itself cannot be seen very high up, on account of the sinuosities of the valley and the lower hills, but the Kubi-gangri is visible in the background.

Neither Ryder and Rawling nor I heard the name Tamjan at the confluence. Ryder calls it Laktsang on his map. I heard only the name Shamsang. But all three names may easily be used for different camping grounds on the plain, where the rivers join. Montgomerie correctly observes that this place, Tamjan Tarjum, reckoned from Maryum-la, is the first actually on the river. That is to say that only here and not earlier, the Brahmaputra begins. Other rivers, belonging to its system, have only been tributaries. Regarding the river, up the valley of which he could see for a considerable distance, it is more than doubtful that it really was the Kubi-tsangpo. I have marked the lower half of this river on my map with a dotted line, because I saw only the confluence and its upper part. The Kubi-gangri is visible W.S.W., as correctly marked on Nain Sing's map. The Kubi-tsangpo comes down from the same direction. But on Nain Sing's map, »the main branch of the river comes down in a straight line from W.S.W., which agrees well with the lower two thirds of Chema-yundung, but not at all with the Kubi-tsangpo. That it is really difficult to judge from where these intricate rivers come is easily visible from Ryder's map, where, again, the directions of the valleys are quite different. Thus Nain Sing has, at Tamjan, seen the confluence or the place where the united Chema-yundung and Maryum-chu falls out into the Kubi-tsangpo. And he has believed that the latter river came from and through the valley which is in fact occupied by Chema-yundung. He reports¹ that: »At Tamjan, on the 7th of June, the river was much swollen, its current rapid and water turbid», which is true for the point where Kubi-tsangpo comes out to the plain of Tamjan. And when the Tibetans said that this river, Tamjan Khamba, was the main branch of the Tsangpo, they meant Kubi-tsangpo, for the junction of the Chema-yundung is situated higher up. Therefore, as compared with d'Anville's map, Nain Sing's map has not at all cleared up the problem, but instead very much complicated the question of Brahmaputra's sources. His view became, however, crystallized in Europe for some 40 years, and in the meantime d'Anville's map became forgotten. And still d'Anville, or rather the Lama surveyors, had made a mistake very similar to Nain Sing's. They had also confounded the source rivers. They divided the Chema-yundung into two different rivers; the upper course was joint with the Kubi-tsangpo, and the lower with the Maryum-chu. Nain Sing believed that the swollen, rapid and turbid river he saw at Tamjan came from W.N.W., which is only the case with Chema-yundung.

¹ Loc. cit. p. 212.

Montgomerie makes the following correct observation:¹ Streams from glaciers are always noted for having exceedingly dirty water, from the action of the glaciers on the rocks and earth in contact with them. Those who have travelled in glacier regions are hardly ever mistaken in deciding as to whether a stream comes from a glacier or not. The Pundit had been acquainted with glaciers all his life. His evidence as to the water would tend to show that the main branch of the river rose among glaciers, and he says that he saw the glaciers. On the other hand Montgomerie supposes that the northern tributaries do not come from glaciers, — on account of the colour of their water. This is true as far as the Maryum-chu and some other northern tributaries are concerned. But such rivers as the Tsa-chu-tsangpo, Chaktak-tsangpo and others, are, at least to a considerable extent, fed by glaciers. As to the main branch and source of the Brahmaputra one could never expect anything else than that it should be fed by unusually extensive and mighty glaciers. And here Nain Sing's observation and Montgomerie's conclusion were correct.

Where is now, according to Nain Sing's report, the source of the river?² Montgomerie does not leave us in the least doubt. It is already given in the title of the quoted article: latitude $31^{\circ} 2^{\prime}$, longitude 82° . This agrees almost exactly with the geographical situation of Tamlung-la, which indeed is the point farthest west in the whole system of the Brahmaputra. The brook going down from Tamlung-la belongs to the Chema-yundung, and thus we have obtained a new proof that the river which Nain Sing calls the main branch of the Brahmaputra is Chema-yundung and not Kubi-tsangpo, so much the more as the description in the text agrees with the map. Or in other words, Montgomerie places the source of the Brahmaputra at some 8 miles S.S.W. of the western end of Gunchu-tso. From this point, Tamlung-la, originates indeed a little tributary to the Chema-yundung, which is itself a tributary.

Under such conditions we are surprised to hear that Chu-Nago is called »the first northern tributary and Chachu Sangpo (Tsa-chu) the second«. Maryum-chu ought to be the first tributary if Chema-yundung were the main river.³

It must be said that from Montgomerie's excellent and conscientious analysis of Nain Sing's report, it was not, however, easy to tell *where the real source* was situated. It seems that the co-ordinates given should be sufficient. But at another

¹ Loc. cit. p. 213.

² One could not help getting the impression that Nain Sing had really discovered the source of the Brahmaputra. The same dogma was afterwards found in many geographical handbooks and articles. Sir Clements Markham, for instance, says, that Nain Sing went »through the upper valley of the Brahmaputra, to the source of that river near the Mânsarovar Lake.« The Geographical Magazine, Vol. II, 1875, p. 41.

³ It is an exaggeration to say: »The river is nowhere fordable from its source to near Lhasa.« For in its upper reaches it can be forded with ponies and yaks, though not without difficulty.

place he says:¹ »From the Mariham-la the road descends gradually, following close to the north of the main source of the Brahmaputra, and within sight of the gigantic glaciers, which give rise to that great river. About 50 miles from its source the road is for the first time actually on the river...» First he says that the road from Maryum-la follows the main source of the Brahmaputra, i. e. the Maryum-chu. Then that the glaciers, i. e. of Kubi-gangri, give rise to that great river, and finally that only after 50 miles from the source is one actually on the river. These 50 miles bring us to Tamlung-la for the Maryum-la is only 30 miles from the confluence. Thus it is impossible to say whether Maryum-la, Tamlung-la or the glaciers are regarded as the source of the river.² Although it is most likely that he regards the branch, which I have identified as the Chema-yundung, as the source.

Between the upper part of this branch and L. Gunkyud Cho, Nain Sing has correctly entered a chain of mountains. But the above-mentioned mighty range stretching N.E. from Gurla and which on his map does not give any change at all to Tage-tsangpo, does not exist. He has entered the Kubi-gangri and its continuation south of the Chema-yundung as a continuous range. He correctly places, «Many Large Glaciers», from which three small tributaries go down to Chema-yundung. There is no sign of the Kubi-tsangpo as in reality the confluence of that river with the Chema-yundung takes place below the junction of the Maryum-chu and Chema-yundung. So that although Nain Sing understood that the Brahmaputra received the greatest amount of its water from these glaciers, he never saw the source branch of the Tsangpo and consequently has nothing to tell us about it in his report, nor on his map. His journey was a beautiful and admirable performance, but as far as the source of the Brahmaputra is concerned his map is a step backward into the darkness, — if compared with the Lamas' map. The same must be said of his representation of the mountains S.W. of the sources. The Lamas knew that the Gurla, the Langchen-kabab, the Tamchok-kabab and the M. Cocoun Kentchian etc., all belonged to one and the same upheaval or fold in the earth's crust. This important truth, which gives the key to the understanding both of the orography and hydrography of these regions, has been disfigured on

¹ »Report on the Trans-Himalayan Explorations, in connection with the Great Trigonometrical Survey of India, during 1865—67: Route-Survey made by Pundit —, from Nepal to Lhasa, and thence through the upper valley of the Brahmaputra to its source.» Proceedings Royal Geogr. Society Vol. XII, 1867—68, p. 146 et seq. Further in T. G. Montgomerie: »Report of a Route-Survey made by Pundit —, from Nepal to Lhasa, and thence through the Upper Valley of the Brahmaputra to its source.» Journal Royal Geogr. Society Vol. 38, 1868, p. 129 et seq.

² Nor has Petermann in his translation of the report been able to make the meaning clearer: »Vom Mariam-la senkt sie (die Strasse) sich wieder langsam, indem sie dem Hauptquellfluss des Brahmaputra nahe an seinem nördlichen Ufer folgt und in Sicht der riesenhaften Gletscher bleibt, welche jenem grossen Strome den Ursprung geben.» Petermann's Mitteilungen, 1868, p. 233 et seq.

Nain Sing's map, from which it was accepted on almost all European maps for some 40 years.¹

¹ The SCHLAGINTWEITS never proceeded so far as to the sources of the great river. But it may be interesting to remember the view of Hermann von Schlagintweit as expressed in his book Reisen in Indien und Hochasien, Band III Hochasien, II Tibet; zwischen der Himalaya- und der Karakorum-Kette, Jena 1872, p. 25. Like most other geographers he supposed that Nain Sing had reached the sources of the Brahmaputra, which he calls Dihóng. And he regards the Maryum-la as situated on the watershed between the Dihóng and Satlej-Indus, which is not the case. But he is right in saying: »Die Quellen des Dihóng sind Gletscherbäche, die in grosser Mächtigkeit der Gletscher- und Firnregion auf der rechten Thalseite entstromen», a statement taken from Nain Sing. In another passage, *ibidem* p. 39, he shows how vague the idea was the great Pundit had given him: »Mittlere Hohe der Quellen, nämlich der verschiedenen Gletscherthore unterhalb des Maryum-la Passes, — 15,200 feet. Of course the sources are not below the Maryum-la. Without knowing the real altitude of the source the calculation of the rate of fall for the whole river down to Sadia in Assam, or 13.9 feet for an English mile, could not be certain. He regards the Dihóng, a name which he uses the whole way up to Maryum-la, as a tributary to the Brahmaputra. But he also relates the Tibetan names, *ibidem* p. 41: »Im östlichen Tibet selbst heisst er Tachog-Khábab = 'Herabgestiegen aus dem Munde des edlen Pferdes'; Tsangbochú = 'Das reine (heilige) Wasser' ist der in Tibet noch allgemeiner gebrauchte Name; für den oberen Theil wird meist Yáru = 'der obere', beigelegt. Auf der Karte der Pandits findet sich noch Mácha Tsángpo (oder Machang Sangpo, wie sie, vom Tibetischen abweichend, schreiben) und Nári Tsangpo. Mácha Tsángpo = der 'Pfauen Fluss'.» But here he seems to have confused the Map-chu or Karnali with the Martsang-tsangpo. On the general map of his and his brothers' routes, the uppermost part of the Tsangpo is better than in his quoted text. But this map was published in 1861 and the source region had not yet been spoilt by Nain Sing. The Lamas and d'Anville were the only authorities. — Speaking of the four *kababs* or vomitories WILFRED L. HEELEY says of the Yaro-tsangpo: »No European eye has seen the head waters of the latter river, which flows from gigantic glaciers south of the Maryam La Pass, fixed by Major Montgomerie's Pandit at 15,500 feet high.» The Calcutta Review Vol. LIX. Calcutta 1874, p. 146. — In 1867 Abbé DESGODINS wrote as follows: »Le Bramapoutre prend sa source dans les Hymalayas, entre la chaîne des neiges perpétuelles et celle qui lui est parallèle au sud, et se prolonge jusqu'à l'extrême est d'Assam; il prendrait ainsi sa source principale dans la Boutan, traverserait la tribu sauvage des Slo, que les Anglais appellent Abords, puis celle des Mahongs qu'ils nomment Michemis et enfin Assam . . .» La Mission du Thibet de 1855 à 1870 . . . D'après les lettres de M. l'abbé Desgodins, Paris 1872, p. 151. Much of his geography is simply taken from Lavallée and Malte-Brun.

CHAPTER XXXV.

KAWAGUCHI.

We left KAWAGUCHI in Hor-tosho after he had crossed the river Kyang-chu.¹ I will now quote some important passages from his description of the uppermost part of the Tsangpo.² On his way farther N.W. he reached four tents. At one day's distance from the station I was to come to Tamchok Khanbab, which forms the upper course of the Brahmaputra, and is the greatest of Tibetan rivers. After 17 miles he reached the Tamchok Khanbab.

The river was a mountain stream of considerable breadth, with extensive sand-beaches on either side. The width of the beach alone on the eastern side was about two and a half miles, and that on the opposite side about half as much; the width of the stream itself, when I crossed it, was not more than a little over a mile . . . The condition of the stream with its cuttingly cold water was much the same as that of the Kyang-chu (except for the greater width to be forded) and the water in some places was not more than seven or eight inches deep; but the sand was so treacherous that we often sank in it right up to our hips . . . Upon terra firma on the other side, my men pointed to a gorge between two mountains rising to the N.W., and told me that I was to go through the gorge, and thence to Lake Manasarovara, after traversing an uninhabited region for fifteen or sixteen days; the road would take me to Manasarovara first and then to Kang Rinpoche:

After that he took farewell of the party, which advised him to recite the sacred text from time to time in order that he might not be set upon and devoured by snow-leopards!

In this case there is no doubt about the river. The Kyang-chu is a southern tributary. But *where* is he, when 15 days more were reckoned to Manasarovar? And where are the broad sand-beaches, and where is the Tsangpo more than a mile broad? South of Tuksum I found the broadest place I saw to be 973 yards across.

¹ P. 115 above.

² Three Years in Tibet, Madras 1909, p. 109 et seq.

But he does not mention Tuksun or any other place in its neighbourhood, and on his sketch map he has not crossed the Tsangpo at all on his way to the Manasarovar. Which is then this extraordinary river?

After leaving the sand-beach of the Brahmaputra he came to another undulating plain, where he followed the upper course of the river to the N.W. and saw the titanic heights of the Himalayas, rising one above another. He found them incomparably more sublime than what one sees from Darjeeling or Nepal, which of course is exaggerated. The Brahmaputra looked like a shining streamer hung out from the bosom of a great mountain, and waving down and across an immense plain and here he composed a verse: The distant clouds about the snowy range pour forth the mighty Brahmaputra stream.

Wherever he is now, he ought to be on the northern side of the Tsangpo, for, coming from the south, he has crossed the river once. However, he continued and found a country full of pools from 100 yards to a mile in circumference. In the afternoon next day he came to the base of a huge mountain of snow, which he could not think of crossing. Then he covered 27 miles without a drop of water either, and was tortured by thirst. *Where* was he? At the upper part of the Tsangpo,— and for miles and days not a drop of water,— in July!

We turn over a few pages more in the book and find the thread.¹ He came to the foot of a mountain, which he climbed and saw a "mountain stream" flowing across the road. The river broadened into a lake, and almost described a right angle when flowing out of this and into another basin. Afterwards I ascertained the name of this river to be Chema-yungdung-gi-chu, and that its waters flowed into the Brahmaputra. He had great trouble in crossing the Chema-yundung and found ice quite thick still along its banks— in July! He walked over and had water up to his shoulders. He estimated the breadth at 180 yards more or less.

The Chema-yundung is the last of the Tsangpo's feeders he touches, and he is right in regarding it as a tributary to the Brahmaputra. He comes from the south. He has crossed the Kyang-chu, the main river and the Chema-yundung. On his sketch-map he has only two crossings, the first of which, Kyang-chu, corresponds in reality to Kubi-tsangpo, and the second to Chema-yundung. But where is the Brahmaputra-crossing? The map is unreliable. What he calls the crossing of the Brahmaputra has simply been the crossing of Kubi-tsangpo. And thus he is right in calling the Kubi-tsangpo Brahmaputra, for in reality it is the upper course of this river and all other watercourses are tributaries.

He was alone with his two sheep and only afterwards he ascertained the name of this river as Chema-yundung. He did not need to ascertain anything regarding the main river which he knew was the Brahmaputra. But where was he told and who told him the name? If he had got it from Chinese texts it would

¹ Op. cit. p. 119.

have been spelt differently.¹ He must have got it from nomads in the neighbourhood and I am glad to see that he spells it almost exactly as I do. His »yungdung» may even be more correct than my »yundung«. I have shown above that the name was well known to the Chinese long ago.

However, he went on for some 5 miles, when it began to snow thick and fast. He went towards the N.W. and climbed a snow-clad peak, encouraged by an uncertain hope of emerging upon or near Kang-rinpoche. Afterwards he ascertained the name of the peak to be Kon Gyu-i Kangri² that rises 22,650 feet above sea-level. From where did he get this exact height of the peak? And where is such a high top 5 miles from Chema-yundung? One of the peaks of Gurla is entered on Ryder's map as being 22,650 feet. The height must have been »ascertained» afterwards. To reach the peak we are told that he turned first north and then east and that he climbed for about 10 miles. He had to take a good long rest on the peak and when he awoke he could not tell whether he had slept for one or two nights!

Then he went down again and after another 5 miles came to another mountain stream, 120 yards wide. Happily he found some tents and stood in the snow asking for shelter.

Then follows the description of the Manasarovar, where he found that not one of the four rivers actually flows directly out of the lake. Only »the sources of the Tamchok Khanbab have hitherto defied investigation»,³ although he should have needed only a few days to reach the very source from the point where he crossed the Kubi-tsangpo, — if my interpretation is correct.

His way took him over Tokchen Tazam to Kong-gyu-i Tso (Gunchu-tso). From here he did not follow the *tasam* and did not cross the Maryum-la, but »went on several low undulating hills, and finally reached the lower course of the river Chema Yungdung . . . As the season was now well advanced, the river was much shallower . . .»⁴ He now rode on a yak . . . After proceeding some twenty-five miles to the south-east, on the following day we reached the Brahmaputra, known in this region as Martsan-gi-chu or Kobei-chu, according to the districts which it traversed.»

This time there is no doubt about his route. He crossed the mountains west of the Maryum-la, went over the Chema-yundung in the middle of its course and then over the lowest part of Kubi-tsangpo, which he calls Kobei-chu. Thus it is really the Kubi-tsangpo which he identifies with the Brahmaputra. He calls it »the lordly river» and makes the Kobei and the Martsan the same river, and here he is correct. But

¹ He cannot have got it from me, for I hardly mentioned the name in my lectures at the Geographical society and the Universities of Japan in November 1908. I mentioned it in February 1909 in the Royal Geogr. Society, but Kawaguchi's book was published the same year.

² On account of its being near Gunchu-tso?

³ Op. cit. p. 144.

⁴ Op. cit. p. 176, 185.

he had crossed the Kobei-chu once before, without mentioning its name. It is a pity that his book appeared a year after I had, in Japan, explained the importance of the Kubi-tsangpo, for, under these conditions he *may, nolens volens* have been influenced by my description.

Kawaguchi was »delighted» to see again »the familiar Kyang-chu river», and so are we, as it proves beyond a doubt that he had so far really only crossed the Chema-yundung and Kubi-tsangpo and was still south of the joint river. He travelled over the ground where WEBBER and his party had seen only »small streams», and where they should have proceeded within sight of Tuksun, — without crossing the uppermost Tsangpo.

Then Kawaguchi travelled 8 miles along the bank of the Ngar Tsang-gi-chu and in the evening he was informed that, in order to reach the high road or *tasam*, he »had to cross the Brahmaputra for a second time.¹ The first time had been when he went over the Kubi-tsangpo. The second crossing of the Brahmaputra seems to have been very comfortable, for he does not describe it. So he reached »the Na-u Tsangbo,² a large river flowing from the northern steppes of Tibet and into the Brahmaputra.» Here the water reached his breast and he was almost swept away by the current. There is not a word of Transhimalaya; he only knows »the northern steppes». On the other side of the Na-u he was told to keep towards the N.E. in order to reach Toksum Tazam.

He mentions Mondan in the province of Lo. »The place Bomba is 15,000 feet above the sea-level; Lhasa is only 12,000», but where is the place Bomba situated? On October 29th, 1900, he found the Brahmaputra »already covered with ice and glittering in the dazzling sun», which seems very surprising. Before Tadun-Tazam (Tradum), he crossed a river 120 yards wide which was »still» covered with ice. Of Tradum he says: It is in fact not a temple but a town (Tazam), one of the most populous and wealthy in northern Tibet.» Tradum a wealthy town in — northern Tibet!

He did not visit Niuk-Tazam but mentions a castle called Sakka Zong and passed south of a snow-clad mountain Chomo-Lhari.³

Farther on his way passes Kur-la, Gyato Tazam, Sesum Gompa, Sang Sang Tazam, Tasang Gompa, the village of Larung, Manuyui Tso, Nam Tso Goga and the valley of Senge Rung. He left the *tasam* over Puntso-ling and crossed the river to continue to Sakya. Finally we find him at Shigatse and Lhasa. He reckons three sacred places in Tibet: Kang Rinpoche, Tsa-ri and »the famous Gaurishankara or Chomo Lhari, often called Mount Everest».

¹ Op. cit. p. 208.

² Obviously d'Anville's Naouc Tsanpou R, and Nain Sing's Chu Nago R.

³ Somewhere hereabouts he saw a strange beast which the Tibetans called »dongyak» (wild yak). It was twice or thrice as big as an ordinary yak and stood about 7 feet high. However, it was smaller than an elephant. The horns measured 25 inches in circumference and were 5 feet in length. These measurements were, however, taken afterwards — on another yak's horns in Lhasa! One gets the impression that too much of his description has been filled in — afterwards.

Kawaguchi has no high idea about the Europeans who have travelled in Tibet.¹ He mentions only Rockhill, Csoma de Körös and myself. As to Csoma I have never heard any European pretend that he had «spent many years in Lhasa».

We leave him now. Priests are often wonderful people. Abbé Huc's book reads like a romance. Kawaguchi's is very romantic also, and though he dislikes the western explorers we cannot help liking him and his lonely ways through the land of the Lamas. In the geographical world of the West such exploration as the following is, however, not accepted: »I wished to take a north-easterly direction, so as to reach a certain post-town; but having no compass, I could not ascertain my bearings, and seem to have strayed off to the south-east and eventually due south, instead of north-east, as I should have done.»² Kawaguchi has not cleared up a single geographical problem. He has unintentionally and in a harmless way turned some of the facts we have known for years upside down. He has no idea of absolute heights, distances, dimensions of rivers and lakes and carries not even a compass with him. Where we knew the water running from the Manasarovar to the Rakas-tal, he makes it run the opposite way. Where the Kubi-tsangpo is some 30 yards broad he makes it over a mile. To him Gaurisankar, Chomo Lhari and Mount Everest are one and the same peak. So it cannot be said to be an exaggerated compliment to Burrard and Hayden, Ryder and Rawling, Waddell and some other British experts and travellers to say that Kawaguchi's book is »probably the best and most up-to-date description of a country which is bound for some time to come to exercise a mysterious fascination over the Western reader.»³ To the mysterious author of these words Tibet will certainly for ever remain a mystery.

¹ Op. cit. p. 403 et seq.

² Op. cit. p. 195. — Poetry may, perhaps, sometimes be welcome even in geography, but such verses as the following cannot be allowed for the *tasam* in the middle of July:

»Upon these plains of snow, my bed is snow, my pillow snow; my food also the same; And this my snowy journey, full of pain.»

³ Geographical Journal, Vol. XXXV, March 1910, p. 325.

Still Kawaguchi's contribution to our knowledge of Tibetan geography is more valuable than the following words about my discovery and determination of the sources of the Indus, Satlej and Brahmaputra: »we hold that claims to have found the true source of this river or that are of little value. The source or sources of every river are the areas of the catchment basin, the ultimate source being the rain or snowfall. One source or channel may carry more water one day, another more the next, and to dogmatize as to one stream rather than another being the true source of a river is unprofitable at any time, and probably incorrect till minute and accurate surveys have been made and discharges observed.» Geographical Journal, March 1910, p. 324.

The determination of the source is never of little value. In the case of a river with such old and great fame as the Brahmaputra it may even be very important to know where and how it is born. A systematic and scientific search for such a source is no dogmatizing and it is not at any time unprofitable to solve definitely such a problem, especially not in our days when very few of the great rivers remain unknown as far as their sources are concerned. Or can it be said that Lord Curzon's extremely clever and learned monograph: »The Pamirs and the Source of the Oxus» (Geographical Journal, July, August and September 1896), has been unprofitable? During a rainy summer one branch of the upper Tsangpo may be greater than others one day, and the next another may be greater. But during a summer like 1907 the conditions are the same all over the area of the catchment basin. And it is absolutely certain that under all conditions and whatever weather it may be, the Kubi-tsangpo is always the greatest.

CHAPTER XXXVI.

RYDER, RAWLING, SANDBERG AND OTHERS.

An important step towards the solution of the problem was made by RYDER in 1904, though he did not approach the source any nearer than NAIN SING had done. Before we go over to the discussion of his results, I will quote the views of two or three authorities, from an epoch when every geographer was still influenced by Nain Sing's report.

On RECLUS' little map we recognize Nain Sing's uppermost Tsangpo which is, as we have seen, nothing else than the Chema-yundung.¹

Reclus, who often quotes his countryman D'ANVILLE, had, in this case, more confidence in Nain Sing. He is right in making a low threshold (Tamlung-la) the watershed between the Satlej and Brahmaputra.

I have shown above that Nain Sing's description in exactness could never be compared with d'Anville's, and that he never clearly told *where* the main source was situated. Therefore such a great geographer as Elisée Reclus got a quite different view than another learned student of the geography of Asia, Professor WILHELM SIEVERS, who places the source in the Maryum-la.²

Thus we have to choose between Tamlung-la, 50 miles from the confluence, and Maryum-la, 30 miles from the confluence. GRAHAM SANDBERG, in 1904, takes

¹ Nouvelle Géographie Universelle, VII, l'Asie Orientale, Paris 1882, p. 45. — Reclus says: »Le fleuve tibétain par excellence, celui qui traverse les deux provinces centrales, le Tsang et le Oui, est le Tsangbo (Tsangpou, Tsambo, Dzangbo, Sampo ou Sambo), c'est à dire 'l'Eau Sainte', appelé fréquemment dans son cours supérieur Yarou-Tsangbo ou le 'Haut Tsangbo' . . . Le même seuil bas qui verse d'un côté des ruisselets de neige fondue dans le Satledj, alimente de l'autre côté le courant naissant du Tsangbo. Ses principaux affluents sont les ruisseaux glaciaires descendus des cirques de l'Himalaya; séparé de la grande chaîne du Kara-koroun par la rangée parallèle du Khomorang, le Haut Tsangbo ne reçoit de ce côté que de faibles ruisseaux.»

² Asien, zweite Auflage, Leipzig und Wien, 1904, p. 460. — »Der Sangpo oder Tsangpo entspringt im Osten der heiligen Seen am Mariamlapasse. Die dortige Wasserscheide ist sehr wenig ausgeprägt, da nur ein relativ niedriger Höhenzug die beiden Quellen trennt, die absolute Höhe ist aber sehr bedeutend und beläuft sich auf etwa 4.700 m. Von dort fliesst der Strom in dem weiten und hochgelegenen Tale zwischen dem eigentlichen Himalaya und den tibetanischen Hochgebirgen nach OSO, im Süden überragt von riesenhaften Gipfeln, während im Norden die grosseren tibetanischen Ketten weiter zurückweichen.»

the precaution to say only:¹ »The sources of the Yeru Tsangpo have not been visited as yet, though they have been pretty-accurately located», by which he can only mean MONTGOMERIE's co-ordinates for the place, which take us back to Tamlung-la. Sir THOMAS HOLDICH holds the other view, for he talks of »the upper Brahmaputra at its source on the Marium La (15,500) — the meridional water parting between the Indus and the Brahmaputra.»² This view was not altered by Ryder's journey, which is quoted in the work.³

Then comes Ryder's admirable survey. We shall have to return to his map here below. In the text he only says:⁴ »We now (from Tradum) followed the river valley for a week or so, always in the same large plains, until we could see the watershed range ahead of us, from the valleys of which innumerable streams issue to form the Tsangpo, the largest coming from a snowy range to the south-west.» Beyond the Maryum La (16,900 feet) he adds: »We had now finished with the Tsangpo, having surveyed it from Shigatse to its source.»

Even this description is not quite clear. It practically gives the same as Nain Sing, except that the main source should be on the Tamlung-la. One gets the impression that the source is regarded as situated on the Maryum-la, and so Holdich's view is quite easy to understand. But Ryder adds an important observation, namely, that amongst the innumerable streams forming the Tsangpo the largest comes from a snowy range to the S.W. It is true that Nain Sing had already seen this range and understood that its glaciers supplied the river with the greatest part of its water. But Ryder precised the question by talking especially of one large stream, which cannot have been any other than the Kubi-tsangpo.

On the same occasion RAWLING says:⁵ »This proved to be our last day amongst the plains of the Brahmaputra, for all that now remained of the great river were numerous channels, which in the rainy season drained the neighbouring hills. The main tributary lay to the south, and obviously terminated in a similar manner.» It is not clear what he means by this termination in a similar manner. But he clearly calls the large stream from the south a tributary. And this is wrong for what he calls the »main tributary» is in reality the Brahmaputra itself.

The question: which »channel» is the main river and where is the source? was thus by no means settled.⁶

Ryder has, however, clearly pointed out his standpoint in a very sympathetic article, which he wrote after our personal meeting at Simla, in September 1908.⁷

¹ The exploration of Tibet, etc. Calcutta, London 1904, p. 4.

² Tibet, The Mysterious, London 1904, p. 39.

³ Ibidem p. 296.

⁴ »Exploration and survey with the Tibet frontier commission, and from Gyangtse to Simla via Gartok.» Geographical Journal, Vol. XXVI. Oct. 1905, p. 387.

⁵ The Great Plateau, London 1905, p. 242.

⁶ In a review, Geographical Journal, Vol. XXVII, Febr. 1906, p. 189, a signature F. E. Y. uses the same term as Ryder's about the survey »up the Brahmaputra to its source.»

⁷ Geographical Journal, Vol. XXXII, Dec. 1908, p. 587.



The Source of the Brahmaputra on Ryder's map, 1904.

He says: »He (the author) then kept south of the river, touching our route at Laktang, and marching up the main branch of the Brahmaputra to its source, which he located accurately and surveyed. In the R. G. S. Journal, Vol. 38, p. 146, Nain Sing mentions being in sight of the gigantic glaciers which give rise to the Brahmaputra. On our journey we surveyed, though only roughly, the main branch»; and then, referring to my expedition he says that, as it was the first to actually follow the main branch to its source, we obtain a more detailed survey than Ryder's own, »which was only a distant sketch». In the same article Ryder returns to my survey of »the true source of the Brahmaputra. This, however, had been approximately located, I think, by Nain Sing, and fairly well surveyed by Rawling and myself», and he adds that as I visited the real source my map would be more accurate. To this I will only add that my map of the source would be of very little value if I had not had at my disposal the admirable and conscientious map of Southern Tibet, drawn by Ryder and his comrades.

But Nain Sing's approximation referred to quite another source, as Montgomerie proves: »The river Brahmaputra was ascertained to rise in about N. latitude $30^{\circ} \frac{1}{2}$, and E. longitude 82° .»¹

I have shown in the preceding chapters how very slowly the European geographers and travellers have approached the source of the Brahmaputra. In some cases, native information seems to have given some assistance. But the very heart had not yet been reached. As I have proved above, two or three travellers cannot at all be taken into serious consideration. Kawaguchi is to be accepted only with the greatest criticism. In reality there remain only two expeditions which have furnished us with reliable results, and of them only Ryder's and Rawling's are first class work (Pl. XVIII). But they never proceeded to the source. They travelled in the winter and could not make any measurements. It is extremely difficult to judge the dimensions of a river during the winter, specially if it is frozen and if the ice and the banks at the sides are covered with snow. This explains the fact that on Ryder's map it is almost impossible to tell which of the southern source-branches is meant to be the Kubi-tsangpo and which the Chema-yundung. On Ryder's map the main river seems to rise just south of Gunchu-tso. From there it flows S.E., and turns, south of a high peak, almost at a right angle, to the N.E. Finally it receives the Maryum-Chu, makes the sharp bend to the S.E. and receives a small tributary just north of Chiru. This last-mentioned river corresponds, so far as the place of confluence is concerned, fairly well with the Kubi-tsangpo. For otherwise there is no room for a Kubi-tsangpo. The river, which in reality receives the Maryum-chu is the Chema-yundung, and so, the river which, on Ryder's map, begins just south of Gunchu-tso cannot possibly be anything else than the Chema-yundung. But where is then the main river the Tamchok-kamba or Kubi-tsangpo? In reality the

¹ Journal Royal Geogr. Society, Vol. 38, 1868, p. 211.

Chema-yundung flows in a fairly straight line E.S.E., and it keeps north of the high peak instead of south of it. Ryder's main river receives two tributaries from S.W. One of them may be meant as the upper course of the Kubi, although, as we know, the confluence of the Chema and Kubi takes place below the confluence of the Chema and Maryum-chu.

Ryder has mixed the two rivers and made the Chema and the Kubi to one river. I do not say this as a criticism of Ryder's brilliant map, which is by far the best ever made of any part of Tibet, and from his route which kept north of the joint river, the Kubi and the Chema, it was practically impossible to solve the problem, nay, even to tell where the different streams came from. I only say it to show how necessary a survey was, step by step up to the very source of the main branch. If we let the Chema, as Nain Sing does, start from the Tamlung-la, it flows in an almost straight line towards the confluence. But if we regard the river from its real source in Chema-yundung-pu, it indeed flows in a sharp angle. This angle points to the north and not to the south as on Ryder's map.

It is curious, from the point of view of historical exploration, to observe that almost the same misunderstanding we have found on Ryder's map was made already 200 years earlier by the Lamas and represented on d'Anville's map of 1733. The Lamas made one river of the upper Chema and the lower Kubi, and they made the lower Chema join the Maryum-Chu. Ryder makes the Kubi a tributary to the Chema, which joins the Maryum-chu. On his map the lower Kubi has dwindled to a separate tributary. Hydrographically the Lama map is more correct, for there the Kubi may also be recognised in the name Tamchok, which is its source.

GRAHAM SANDBERG in his last book¹ returns to the problem of the source of the Tsangpo, and it should be remembered that it appeared after the publication of Ryder's and Rawling's reports. Sandberg translates Támchhok Khábab by »the downflowing mouth of the best horse² and says the Támchhok is a fabulous steed

¹ 'Tibet and the Tibetans,' London 1906, p. 74 et seq.

² In his Tibetan-English Dictionary, p. 531 and 1,000 Sarat Chandra Das says of our river and its name: »rta-mchog 'the best horse', the ideal horse which makes its possessor a wealthy man; the mythological horse of Indra, a sort of Pegasus which partakes of divine properties . . . He is called Baláhaka the prince of horses . . . Rta-mchog Kha-hbab lit. 'the down-flowing mouth of the best horse'. This is the appellation of the Yeru = Tsangpo or Brahmaputra during the earlier portion of its course in Western Tibet. Throughout Ngari it is known as Tamjo Kha-bab. The river is supposed to issue from a rock shaped like an horse's mouth, but in reality rises in a swamp in a mountain-locked valley 12 miles east of Gur-lha in West Purang.» From a Tibetan source he adds the following quotation: »Rising from the eastern range of Kailas and receiving the waters of the streams coming from Byan, Nags, Tshangs, it flows eastward past Lhar-tse and Phun-tsho-ling . . .» F. von Zach translates Zang-bochu, or gtsang-po-ch'u with »Strom der Reinhet».

Looking up some old and new editions of the map of Tibet in Stieler's Hand-Atlas, I find, in the edition of 1849 by F. von Stulpnagel, for the upper part of the Tsangpo, the names Tamduj, Eritschumbo and Yaru-zzang bo-tsiu; the same nomenclature is found on Berghaus' great map of Asia. In the edition of 1861 by Hermann Berghaus the names are the same except Tamdschu instead of Tamduj; in the edition of 1875, by A. Petermann the river is called Brahmaputra or Tamdschan Khamba, which comes from Nain Sing's map and, further down: Jaru-dzang-bo and Dihong; in the

petrified in Lake Mápong from the rocky mouth of which creature the river is supposed to gush forth. Yeru Tsangpo he translates as »the river of the right-hand banner». The following passage, in which he first describes the source and then says it is unknown, is, however, of great interest and must be quoted in full: »In fact the Yeru Tsangpo has its sources in a long narrow valley cradled in a remarkable manner between three separate ranges of mountains, each of which is literally loaded with glaciers. — Into this womb of the Ice Mothers which, conjointly, breed the mighty Brahmaputra, even Tibetans themselves have scarcely ventured. The only entrance seems to be at the S.E. extremity of this mountain-locked valley, at the end where the river issues forth. No tracks pass up the valley; for the mountains at the head of it, which separate the valley from the lakes at the base of Mount Tisé Kailas, have no way over them, and the whole terminates in a stupendous cul-de-sac. The actual place where the river first forms is said to be a large gravelly marsh, fed from the adjacent glaciers, and styled Chema Yundrung 'The sands of the Mystic Wheel'. This lies at an altitude of about 14,700 feet above the level of the plains of India . . . — Lonely, impenetrable, unknown, it seems meet that the weird and famous stream should thus be born in utter secrecy in this remote valley so far to the west. — But the solitude must be one not of barrenness, but of grandeur. On three sides, let us remember — N.W., N.E., S.W. — the birth-place is girt about by monster sentinels crowned with helmets of never-melting snow and standing shoulder to shoulder with glaciers for each epaulette.»

It is a pity that Sandberg has not quoted his own sources when speaking of those of the Brahmaputra. His description gives the impression that he has spoken with some Tibetan who has been, or who has known somebody who has been to the sources of the two southern rivers. The long narrow valley surrounded by ranges loaded with glaciers is not at all unlike the source of the Kubi-tsangpo. It is correct

edition of 1901, by E. Debes, H. Habenicht and C. Barieh, the names are Brahmaputra, Tamdschan Khamba, Tschang-tsehu and Sangpo; in the edition of 1904 by B. Domann we read Tamdsehan-chamba (Brahmaputra), Matschang-sangpo, Sangpo and Dihong; in the editions of 1909, 1910 and 1911, by B. Domann and H. Habenicht, the river is called Tsangpo or Brahmaputra.

As a rule, in this list the older editions are richer than the newer, for Tamchok-kamba is the most common name one hears, at least above Raga-tsangpo. Ertschumbo is the same as and a bad spelling of Yaru-zzang-bo. Nain Sing spoils Tamdschu to Tamdschan (Tamjan) but improves it by the addition of Khamba. In the 1904 edition Matschang-sangpo appears, which is also a very common name for the river in its upper reaches, although the right spelling is Martsang-tsangpo, »Trans-Himalaya», II, p. 90. On the best general map of Tibet in England, »Tibet and the surrounding regions published by the R. G. S. 1906, the following names are entered: Martsang or Tsangpo, Yarimartsang or Tsangpo, of which I never heard the latter combination, for Martsang-tsangpo and Yere-tsangpo are two different names. Nain Sing has heard the two most common names of the river, although he has misspelt them: Tamjan Khamba and Machang Sangpo. Lower down, between Shigatse and Chaksam Ferry, he has also Nárichú Sangpo, which I never heard, although it is not at all unlikely, for Ngari-chu-tsangpo should simply mean the river from Ngari. Where the Maryum-chu joins the principal branch, Nain Sing has a *tasam* or house on the great post road, called Tamjan, which points to the fact that it is only after the junction with the Kubi-tsangpo that the river is called »Tamjan Khamba».

to say the entrance to the source-valley is from the S.E., and not from the N.E., as would seem more likely. But the whole description loses a good deal of its importance when we are told that not Kubi-tsangpo but Chema-yundung is meant. This explains his saying that the mountains at the source separate the source-valley from Manasarovar and Rakas-tal, which is indeed the case. The actual source is said to be a large gravelly marsh, which does not, however, well agree with the long, narrow valley in which it should be situated. I cannot, however, judge in this case, as I never went up to the source of the Chema-yundung-chu. The topography may be very like that of the Kubi-tsangpo. That the river comes from glaciers is certain and at their foot there may be a gravelly marsh as well as at the foot of Kubi-gangri.

How does Sandberg know that the glaciers which give rise to the Chema-yundung are situated N.W., N.E., and S.W. of its valley? It is not probable that any glaciers exist N.E. of the source. This problem will have to be solved in the future and the very source of the Chema-yundung, even if well known by certain Tibetan tribes, has not yet been discovered by any European.

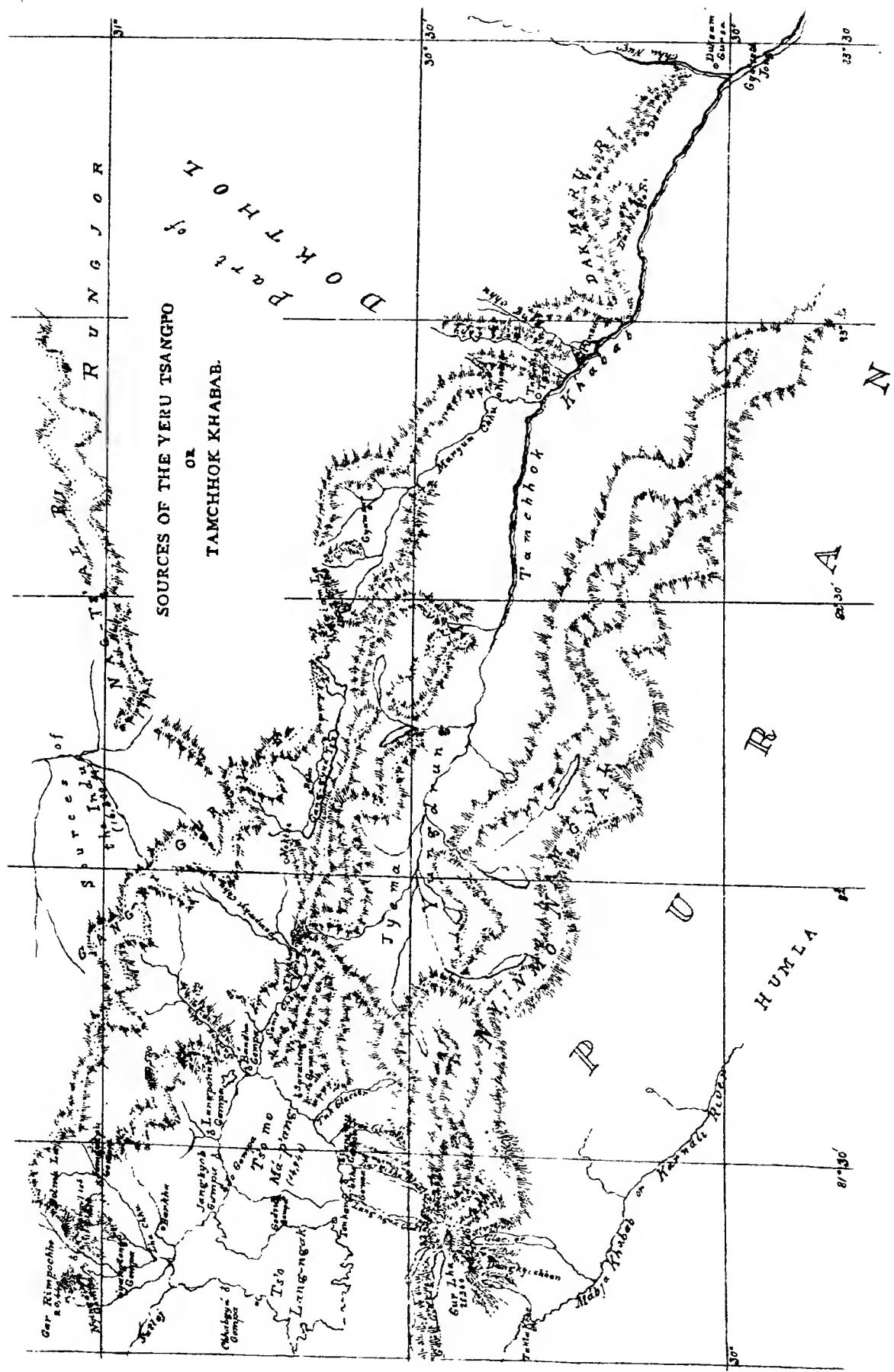
The following passage confounds what he has said before: »The Sands of the Mystic Wheel, whence the river takes rise, are closely hemmed in by parallel ranges trending south-eastwardly. The northern range, Gang-ri Gur-gyab, shuts off the sources of the Indus. The southern wall is a massive ridge developed from Gur Lha, itself a stupendous mountain-matrix flung up to the south of Ts'o Mápang. This ridge bearing the name of Nyimo Namgyal, 'that which completely vanquishes the sun', eventually makes to the S.S.E. to form the watershed lower down between the Tsangpo and the rivers of Nepal.»

Here we are told that the source of the Chema-yundung, the large gravelly marsh, is closely hemmed in by parallel ranges, the northern of which is not only a watershed to the Indus, but to its very sources, which is absurd, as they are situated north of the Transhimalaya, in another part of the country. The northern range is called Gang-ri Gur-gyab, a name sounding like Kawaguchi's Kon Gyu-i Kangri.

Thus Sandberg locates the source of the Brahmaputra close on the southern side of a range, on the northern side of which the sources of the Indus are situated.

As the first fixed geographical point he regards Mariam or Mai Yum La »the Mother of the Lowlands Pass.¹ He correctly describes the Maryum-chu as a tributary: »The descent we are now traversing from the Mariam La does not yet touch the great waterway. The combined route at first keeps laterally along the northern side of the valley and is accompanied by a small river formed by streams from the heights abutting the Mariam Pass. This path has to be traversed some thirty miles further before the merchants, packmen, and pilgrims come in sight of the mighty Támchhok (or Támchhen) Khabab travelling grandly eastwards. However, the banks are not actually gained until the post-stage named Támchhen Tázam has been

¹ This translation seems to be more correct than that of B. von Zach, who writes: »Maryung la, maryong-la, glänzender Pass.»



Sandberg's map 1896.

reached; and there too, the branch-stream just mentioned falls into the main river, which by this has travelled some fifty miles from its source.»

Thus Graham Sandberg's hydrography clears up by degrees. His standpoint is very much like Nain Sing's and Montgomerie's. But he points out that Maryum-chu is only a branch-stream joining the mighty Tamchok-kamba. From the confluence to the source he gets the same distance as Montgomerie, or 50 miles, which is quite correct whether the source of Chema-yundung be placed at Tamlung-la, as Montgomerie has it, or at Chema-yundung-pu, where Sandberg, to judge from his description, has placed it. In the essential point, however, he is wrong. He regards the Chema-yundung, just as Nain Sing and Montgomerie, as the upper course of the Tamchok-kamba. And he does not know the existence of Kubi-tsangpo. He does not say where the Tamchok-kabab itself is situated, only that the 200 first miles from the source the river »still carries its ancient title Támchhok Khábab», which, however, in reality is Tamchok-kainba, for *kabab* means source.

Still more important and interesting than his chapter on the source of the river is Sandberg's map: *Sources of the Yeru Tsangpo or Tamchhok Khabab*, which was published in 1896 (Pl. XIX).¹ It seems to be compiled from all material existing, combined with the information quoted in this chapter. The sources of our three great rivers, the Indus, Satlej and Brahmaputra, are all entered on the map. Respecting the source of the Indus he is so far correct that he does not place it on the Kailas, but has removed it a considerable distance to the east and south. On his map it takes its rise on the northern slopes of the range Gang-ri Gur-gyab. The Satlej goes out from the Rakas-tal, Ts'o Lang-ngak, and there is a communication between both lakes. From a glacier on the northern slope of the Gurla a brook goes down to the Manasarovar, called Lang-ngak glacier, a name that I never heard of in this region, and which is obviously a mistake. The brook called Tak Glacier which enters the Manasarovar from S.E. is, of course, Tage-tsangpo. The Tamchhok Khabab, finally, is formed by some eight brooks, all of about the same size, and each coming from a glacier. A comparison with my map will show that this representation has no likeness with reality. The text is even better. The whole region where the brooks join he calls Tyema Yungdrung, and the range to the south is called Nyinmo Namgyal.

In 1906 Sir GEORGE GOLDIE says in his address *Twenty-five years' geographical progress:*² »The recent Tibet expedition practically settled the question of the sources of the Brahmaputra, and laid down its central and upper course.» So late as in 1910 Major R. L. KENNION in his entertaining book³ still regards »the

¹ The Calcutta Review October 1896, where Sandberg has printed an article: »The great river of Tibet: its course from Source to out-fall», p. 219 et seq. The chapter of his book quoted above is word for word the same as this article.

² Geographical Journal October 1906, Vol. XXVIII, p. 379.

³ Sport and Life in the Further Himalaya, Edinburgh and London 1910. There is no geography whatever in this book.

sources of Indus and Brahmaputra» as »mystic», although I had described both in 1909.

In 1907 the last word had not been said in this question. Lord CURZON has expressed the situation thus: «When a traveller pursues earlier investigations a few stages further, on lines already followed and accepted but not carried to their logical or geographical conclusion, he determines.»³ This view is correct — if Chinese sources are considered. All other material was insufficient. Both Nain Sing and Ryder confounded the Chema-yundung and the Kubi-tsangpo. Kawaguchi is the only modern traveller who mentions both rivers, even by their correct names, although his results were not yet published or known when I published mine. But even Kawaguchi says: »the sources of the Tamchok Khanbab have hitherto defied investigation».

³ Geographical Journal Vol. XXXIII, April 1909, p. 436, under the title: »Scientific results of Dr. Sven Hedin's expedition.»

CHAPTER XXXVII.

THE SOURCE OF THE BRAHMAPUTRA.

On July 6th, 1907, I camped on the right or southern bank of the Martsang-tsangpo or upper Brahmaputra at a place called Chärok, the same that is called Chiru on Ryder's map. The number of the camp was 195, the absolute height 4,657m. (15,275 feet). Early in the afternoon I measured the volume of water in the river, which here flows in a narrow, well-defined bed. The breadth of the river was 47.45 m.; the depth was measured at 11 points at equal distances from each other, the deepest being 1.52 m., and the average depth 0.996m. The velocity of the current was measured at the surface, in the middle and at the bottom at every point where the depth was sounded, which makes in all 33 readings of velocity. The average of all these readings makes 0.930m. a second. The volume of the river was therefore 43.95 cub.m. a second. It seems surprising that this river carried only one and a half times as much water as the volume which every second reaches the Manasarovar, or 28.65 cub.m. Both values are so far comparable, as the measurements were undertaken during the same dry summer. But it should be remembered that the Tsangpo at Chärok, which is not very far from the source, rises very considerably towards evening and night, when the water which during the sunny hours of the day has been melted on the glaciers, has had time to flow down so far. The above value of 43.95 cub.m. therefore probably signifies the lowest ebb of the pulsations within the 24 hours. Proceeding, day by day, upwards to the source the high-water will of course be met earlier in the day, until, finally, at the very source, there will not be any delay at all, and the ebb or low-water will enter during the latter hours of the night and the early morning. This should be borne in mind when we consider the following measurements.

At Chärok a little rock stands at the right bank of the river; the road follows the left bank to the N.N.W. A now dry summer-bed is crossed. Tabuk is a tributary valley entering from the west. The river is here divided in several branches and can be crossed on horseback. In the rainy season it is so swollen that even yaks cannot swim through the strong current. A ridge of hills reaches the very left

bank, and the river forces the road to cross them in a little threshold called Penge-la, situated in gabbro, more or less metamorphized. Beyond this place the country becomes open and flat; three tents are seen and numerous camping places now uninhabited. One road joins the *tasam* which is seen coming down from a little hill called La-rok. Turning more to the west along the river we become aware of a series of *gangris* to the S.W. and W.S.W., and already at the first sight of this beautiful landscape one understands that only amongst these gigantic alps can the source of the river be situated. Already Nain Sing had suspected that the Tsangpo must get most of its water from the glaciers coming down from this high range, and Ryder had told us that the strongest arm of the Tsangpo came from there. It only remained to prove by direct observation on the very spot that such was indeed the case, and to follow the river up to its very source. This had never been undertaken before, except perhaps, by the Chinese, and this was my goal when I started south-westwards with three excellent guides, and a few of my own servants.

On the wide plain of Shamsang my Camp 196 had a height of 4,697 m. (15,406 feet); 21 tents were now pitched here. The mountains round the plain seem to be very arid, and in the strong, bright sunshine they appeared rose-coloured. The following bearings may be noted: Tingsi-larguk is a valley from the S.W.; the Maryum valley with its river and the *tasam* is seen to the N. 55° W.; the mountains to the N.W. are called Särkung; N. 6° W. is the valley Ukpa-lung, and straight north the valley and mount Gangchen; N. 7° E. is a valley called Ülung or Yülung with a road over the Transhimalayan pass Ülung-la to Rundor and Gertse; N. $30-35^{\circ}$ E. is a dominating and steep mountain, Lasar, with a valley of the same name; N. 51° E. is the conical mount Palboche; N. 60° E. we have the valley of Lungmar with a road to Lungmar-la, one of the principal passes over the Transhimalaya; some peaks in the same direction are covered with snow. To the N. 66° E. and N. 70° E. are the northern valleys Tsakyur and Rungkü; N. 80° E. is a mountain called Pagmartaon; N. 84° E. is a valley and pass Hlalung with road to Tabie-tsaka and Bongba; S. 77° E. mount Tangyung; S. 60° E. a region Tsagong-kongji; S. 50° E. the great valley of the Tsangpo appears like an interruption between the mountains.

A very short distance S.S.E. of Shamsang, at the northern foot of some small gneiss rocks, is the very important point where the Martsang-tsangpo is formed by two rivers, the Chema-yundung and the Kubi-tsangpo. After having flowed almost parallel with each other for some distance they join at the very foot of the low rocks. Between them, and north of them the ground is swampy; there are several river-beds, now without water, and it is easy to see that considerable parts of the banks become inundated in the rainy season. Some good grass grows on the plain, though only four tents were pitched at the junction.

The measurements were undertaken from 9.30 a. m. till 12 o'clock noon, on July 8th. The distance between Camps 195 and 196 is only 9 km; the high-water had passed during the night. The first measurement was made below the

junction, thus including all the water of the Kubi-tsangpo, Chema-yundung and Maryum-chu together. The river was divided by a little island into two branches of which the right one was a mere brook. The great branch was 48 m. broad, had a maximum depth of 1.28 m., an average depth of 0.722 m., an average velocity of 1.247 m. a second, and a volume of 43.20 cub. m a second; the brook south of the island had a breadth of 4 m., an average depth of 0.215 m., an average velocity of 0.855 m., and a volume of 0.73 cub. m. a second. The whole river carried thus 43.93 cub. m. or precisely the same volume as the day before, 43.95 cub. m.

Immediately afterwards, I measured the northern branch, which contains the water of the united Chema-yundung and Maryum-chu. This branch had a breadth of 24.7 m., a maximum depth of 0.99 m. an average depth of 0.48 m., an average velocity of 0.84 m. and a volume of 9.97 cub. m. a second. As the whole river had 43.93 cub. m. there remains therefore 33.96 cub. m. for the Kubi-tsangpo; which makes, in round figures, 34 cub. m. for the Kubi, and 10 cub. m. for the united Chema-yundung—Maryum-chu. The Kubi-tsangpo is thus $3\frac{1}{2}$ times stronger than the Chema-yundung and Maryum-chu taken together. I had no opportunity to answer the question which of the two last-mentioned rivers is the greater. But this is of no importance whatever. Probably the Chema, as coming from glaciers, is greater than the Maryum-chu. With the first measurement the problem is solved without the slightest shadow of dogmatizing. The observations were made simultaneously. Had I measured one river at noon and the other at 5 o'clock the result would have been false. Had I made the observations during a rainy summer the result would not have been reliable, for more rain could occasionally have been falling in the catchment area of the one river than in that of the other. The summer of 1907 was very dry and everything was favourable for the hydrographic observations, the sources of error being almost entirely excluded. Under such conditions it was superfluous to ask the Tibetans of Shamsang for their opinion, but all of them agreed that the Kubi-tsangpo was the upper course of the Martsang-tsangpo or Brahmaputra. So it has always been and so it will ever remain.

The next step is very simple: to follow the Kubi-tsangpo to its origin!

From Shamsang it is a short march of only 6 km. to Umboo, Camp 197, at 4,702m (15,422 feet). The road follows the left bank of the Chema, including the water of Maryum-chu. The Maryum-chu splits up in a delta of 9 branches before joining the Chema. All these branches are crossed by the road. I measured them all, but the result has very little value, as the branches were not measured simultaneously. Moreover, from my road I could not control whether all these nine branches really belonged to the Maryum-chu. To judge from Ryder's map some of them seem rather to come from small Transhimalayan valleys, just east of the valley from Maryum-la. However, I believe my Tibetans were right in assigning them all to the Maryum-chu.

At Umboo, where green schist and schist-breccia crops up on the right bank of the Chema-yundung, these branches of the tributary water were measured. No. I

had the dimensions: breadth = 2.0 m., depth = 0.215 m., velocity = 0.823 m., volume = 0.354 cub. m; No. II: breadth = 7.6 m., depth = 0.37 m., velocity = 1.04 m., volume = 2.92 cub. m; No. III: breadth = 3.9 m., depth = 0.22 m., velocity = 0.15 m., volume = 0.129 cub. m. Between No. II and No. III the Chema-yundung, including the six upper branches of the Maryum-chu, had the following dimensions: breadth = 29.8 m., depth = 0.525 m., velocity = 0.976 m., and volume = 15.26; to this the volumes of the separately measured No. I and No. II have to be added, which gives the whole volume at 18.53 cub. m. The first measurement, which gave 9.97 cub. m., was made at 11 o'clock, the second, of 18.53, at 4.30 p. m. This gives an idea of the very considerable swelling of the rivers towards evening. But as the same is the case with the Kubi-tsangpo the proportion will always be about the same.

The remaining Maryum-chu branches are situated just west of Umboo. They had the following dimensions: — No. IV: breadth = 11.0 m., depth = 0.15 m., velocity = 0.65 m., volume = 1.07 cub. m.; No. V: breadth = 9.8 m., depth = 0.34 m., velocity = 1.39 m., volume = 4.6 cub. m.; No. VI: breadth = 4.0 m., depth = 0.16 m., velocity = 0.047 m., volume = 0.028 cub. m.; No. VII: breadth = 6.8 m., depth = 0.14 m., velocity = 0.64 m., volume = 0.609 cub. m.; No. VIII: breadth = 12.0 m., depth = 0.19 m., velocity = 0.92 m., volume = 2.09 cub. m.; No. IX: breadth = 6.0 m., depth = 0.43 m., velocity = 1.06 m., volume = 2.73 cub. m.

All the Maryum-chu branches thus carried 14.53 cub.m. together, though, as shown above, this value cannot be compared with the results from Shamsang.

From Umboo the road takes us W.S.W. and west to Camp 198 at Tok-jonsung on the Chema-yundung, where the height is 4,732 m. (15,521 feet). Just west of Umboo there are several beds, which, in the rainy season, become inundated by the Maryum-chu, but were now perfectly dry. It is pretty certain, however, that by far the greatest part of this water comes from the *sum-la* or three passes of the Transhimalaya, which were known to the Chinese, but are still unknown to us, — and not from Maryum-la.

Continuing westwards we leave the valley of Rachen on our right, from which the Maryum-chu comes down. A little rocky promontory here consists of graywacke sandstone. A little isolated rock on the right bank of the Chema-yundung, called Punti-pakto-naya, consists of the same kind of rock. At this point the river, divided into four branches, is crossed, and the road then follows along the right-side erosion terrace which is 2 to 3 m. high, rounded and old. Between the foot of this older terrace and the edge of the present one, is level steppe, with good grass. From the left, that is to say from the mountain ridge between the Maryum-chu and Chema, two tributary valleys join the latter, the first called Lanta-ji. To the N.N.W. a dominating peak with some snow, is called Rachen-sagre. At Tok-jonsung, where nomads dwelt in three black tents, the Chema is slow and deep, but not far from that place it forms small rapids. The hard S. W. wind carried much sand and dust through the valley.

From Tok-jonsung our road proceeds south-westwards on the top of the terrace and at some distance from the river. The panorama of sharp peaks with eternal snow and glaciers becomes more and more fascinating as one approaches. Once more the road touches two very sharp bends of the Chema-yundung. It is surprising to find such a slow current at so short a distance from the mountains. Sometimes the river is more like a series of lakelets or basins with hardly any visible current at all. From a distance the river therefore looks much larger than it is. At some places in the bed there are transverse thresholds of gravel, and over them the water forms rapids. The volume I estimated at 4 or 5 cub. m. a second, before noon, and before the high-water of the day had reached so far. No tributaries were seen on the day's march. The valley is here very wide and flat; the river flows along the foot of the reddish rocks at its left, or northern side; to the S.E. of our route the country is hilly. No animals are seen except rabbits and ravens. The snow-mountains to the W.S.W. are called Chema-yundung-pu, and from them the river is said to come down. To the N. 30° W. one sees the opening of the comparatively narrow valley from which the river comes and makes its entrance on the valley-plain we are just crossing.

The road now enters a labyrinth of low, rounded hills of sand, gravel and blocks of all sizes, without any kind of vegetation. They are old moraines, often stretching as rounded, but fairly steep ridges to the N.E. There are some semi-circular moraine-walls with depressions inside, which obviously become filled with water after rain. Only one of them now contained a little moraine-lake called Tso-täri, about 100 m. across. The moraine-belt soon comes to an end, and is followed by slowly rising steppes with grass on sand and clay. Shäryak, Camp 199, is at 4,874 m. (15,986 feet) near the mouth of a valley coming from the S.W., and with a broad bed of grey gravel without water. The living rock is here granite, quartzitic sandstone, fine-grained sandstone, and pyroxenite.

On July 11th the journey was continued direct S. W. The more we approached the northern foot of the mountains, the earlier in the day the strong S. W. wind used to set in, and the harder and more piercing the wind became. Ryder and Rawling had hard wind in the winter on their road over Maryum-la and so was the case with Father Desideri. At Camp 200 we came across several rather large sheets of fine thin bark, light as paper, which had obviously been carried away by the S. W. winds over the mountains from their homes on the southern side of the Himalayas. The Tibetans were quite accustomed to see such sheets of bark, and said the trees from which they came formed forests round a place called Mogum. However, this transport of solid material over the Himalaya is a proof of rather strong winds from the south.

Our road goes up the Shäryak valley rising slowly between low hills. Gravel and blocks of granite are seen, but no living rock is passed the whole day. There is some grass and moss in the valley, but its sides are arid. Here and there snow patches

still keep their ground. Small ravines enter from both sides; one of them, from the right, or S.E., is called Shäryak-puli. Finally the little pass Tso-niti-kargang is reached; its height is 5,138 m. (16,853 feet). On its southern side the ground slopes down to the Kubi-tsangpo. The ridge, in which this pass is situated, is a ramification from the mountains to the S.W., and stretches N.E. forming a watershed between the Chema-yundung and the Kubi-tsangpo. To the N.W. of this ridge we find only tributaries to the Brahmaputra; to the S.E. the uppermost Brahmaputra itself. Therefore the ridge of Tso-niti-kargang has a certain importance.

Though the pass is not very high it gives us a very extensive and most instructive view. To the N.W., N., and N.E. there is a perfectly hopeless labyrinth of ridges, ranges, ramifications and peaks, all of about the same height, and therefore with a general surface which looks almost horizontal. There are no dominating ranges or peaks; it has the appearance of a stormy sea with petrified waves, a »Red Sea», for red nuances prevail in these arid mountains. In this sea, Maryum-la disappears altogether. However, the view does not extend sufficiently far to the north to reach the gigantic range in which the Ding-la is situated, and very little snow is to be seen.

To the south the view is surprising. The Himalayan giants, which from Shamsang, Nain Sing's and Ryder's route, had been seen at a great distance, now presented every detail of their wild, black, rugged peaks, the *nevées* in the background, and the mighty glaciers between the rocks. To the S. 50—60° E. there is a sharp black ridge, Taptuk, rippled with snow; beyond it, south-westwards, two other ramifications are visible. S. 30° E. a double snow-covered peak is called Lungyung. S. 5° E. is a valley with a large brook in several branches, a tributary to the Kubi-tsangpo; a snowy mountain in its background was said to be called Rargam-nakpo. Direct south are two snow-covered cupolas. To the S.S.W. we have, just under our pass, the small lakelets of Tso-niti, beyond which the Kubi-river runs its dark grey and brownish water through its bed. In the same direction and quite close to the right bank of the river is a lake, the colour of which sharply contrasts with that of the river, for its water has a fine blue-green colour. S. 16° W. is a nameless peak. To the S. 25° W. is a snowy mountain Tsebo-che, and S. 38° W. another, higher, called Absi. In the background between both, very extensive *nevées* are visible and in the foreground between them appears a glacier called Ngoma-dingding after a peak appearing in the background. From the pass one gets the impression that the Kubi takes its origin from the Ngoma-dingding glacier. The dark muddy water seems to gush out directly from the front of its snout in sharp contrast to the blinding white surface of the glacier, where only at a few places blue and green nuances of ice are to be seen. But this is only an optical illusion, for the greatest amount of the water comes from farther west, from regions which are still hidden by hills. To the S. 40° W. is a small double peak, called by one of my guides Mukchung-tseung, by another Mukchung-simo. It was

Pit KUM-TSANG-PO AND ITS GLACIER-SOURCES FROM CAMP 200



easy to control the information given, and to find out that the same names were always given to the same objects by all three guides if questioned separately. Later on the Mukchung-simo proved to be, not a double peak, but a prismatic ridge. To the right of it, south-westwards, was a distant peak called Gave-ting. To the W.S.W. and W. are several other peaks and some considerable glaciers, amongst them Chema-yundung-pu, the cradle of the river of the same name. N. 72° W. is a black peak, Dugri, visible from the road to Tage-tsangpo.

The bottom of the valley and the whole foreground of the landscape is dominated by the heavy grey rapids of the Kubi-tsangpo, which already here, at the front of its mother-glaciers, makes the impression of a mighty river receiving some strong tributaries from its right side. Grass grows on the banks, close and low as velvet; the ground is a little undulating; it is a rough, cold, and windy region, a high-alpine nature, a magnificent and picturesque view, the cradle of one of the most famous rivers on the earth.

At the southern foot of the little pass are the three small moraine-lakes, Tsouniti, dammed up by the front-moraines of old glaciers, which have now retreated into the mountains. The three lakes are at different absolute altitudes though the difference is only a few metres. Again we cross a labyrinth of old moraines, some of them rather steep. To our right, N.W., stretches the ridge we have just crossed, and from its crest several now dry ravines go down to the left side of the Kubi. Camp 200, Hlayak, is at 4,861 m. (15,944 feet), near a little moraine-pool and a brook from a spring. This is a well-known camping-ground; the grass is good, and, at the end of July, 15 or 20 tents arrive to pass six weeks at Hlayak, or until the first snow forces them to return to Shamsang and Chang-tang. During the winter the snow is generally some five feet deep in this region, and if a heavy snowfall comes early in autumn the situation of the nomads and their flocks may be very critical. Ryder and Rawling had $1\frac{1}{2}$ foot of snow even on the Maryum-la with its half Chang-tang climate. My guides, who used to pass the summer at Hlayak and still further south, informed me that when the great masses of snow, which during the winter fall in the upper reaches of Kubi-tsangpo, begin to melt in the late spring at the same time when the ice of the river breaks up, a very considerable amount of water flows down through the bed of Kubi-tsangpo. This high-water of the spring was even said to be more considerable than the high-water of the rainy season in the autumn. This may indeed be the case in these uppermost regions, but lower down the Martsang-tsangpo certainly rises more in the autumn than in the spring.

Near Camp 200 a right tributary, Lungyung, from the S.E., enters the Kubi; its brook comes from a mountain region called Lungyung-pu. Below this valley, and the whole way to the junction with the Chema-yundung-pu the Kubi is said not to receive a single tributary worth mentioning, only small, usually dry ravines. Even here, so near the source, the Kubi is very difficult to cross. After sunny summer-days it is impossible, but after cold cloudy days the river sinks and may be forded

at many places. It is not the amount of water which causes difficulties, for the Tsangpo is fordable even below Tuksun; it is on account of the blocks and boulders in the bed.

I cannot be responsible for the correctness of the following geographical information given by my guides, but as they proved to be very reliable in everything else I think it worth while to relate their description of a completely unknown part of the Himalayas. They asserted that somewhere to the S.W. was a snow-covered pass, Tabsi, with a difficult and hardly ever used road leading across the high mountains to the valley of Map-chu or Kauriala. Tabsi-la should thus be situated somewhere in the same range to which the Kubi-gangri, Chema-yundung-pu and Ganglung-gangri belong. But from Tabsi-la one does not by any means come down directly to Map-chu, as could be expected. One comes down to the source region of Gyang-chu or Kyang-chu, the lower course of which I crossed near Camp 194.¹ Continuing southwards one has to cross a second range of mountains in a pass called Nangsa-la. The source of Gyang-chu is situated on the north side of this pass. To the south from Nangsa-la one comes to a region called Mogum, from the forests of which the sheets of thin bark we saw are said to be carried by the winds. This can hardly be anywhere else than in the Map-chu valley. The Gyang-chu should therefore partly be fed from the southern side of the Kubi-gangri and, further east pierce the range, the highest part of which is the same Kubi-gangri. But then one would expect to find the Gyang-chu as a very considerable river, which is not at all the case. However, very much depends upon the general configuration of the mountains. If the southern branch of the Tage-tsangpo, which Ryder has marked with a dotted line on his map, really has the course Ryder believes, then a good deal of the water from the southern or rather western side of the Kubi-gangri group goes to the Manasarovar. Another part may go to the Map-chu, and only a comparatively small remainder to the Gyang-chu. Probably only the S.E. part of the Kubi-gangri group drains to the Gyang-chu.

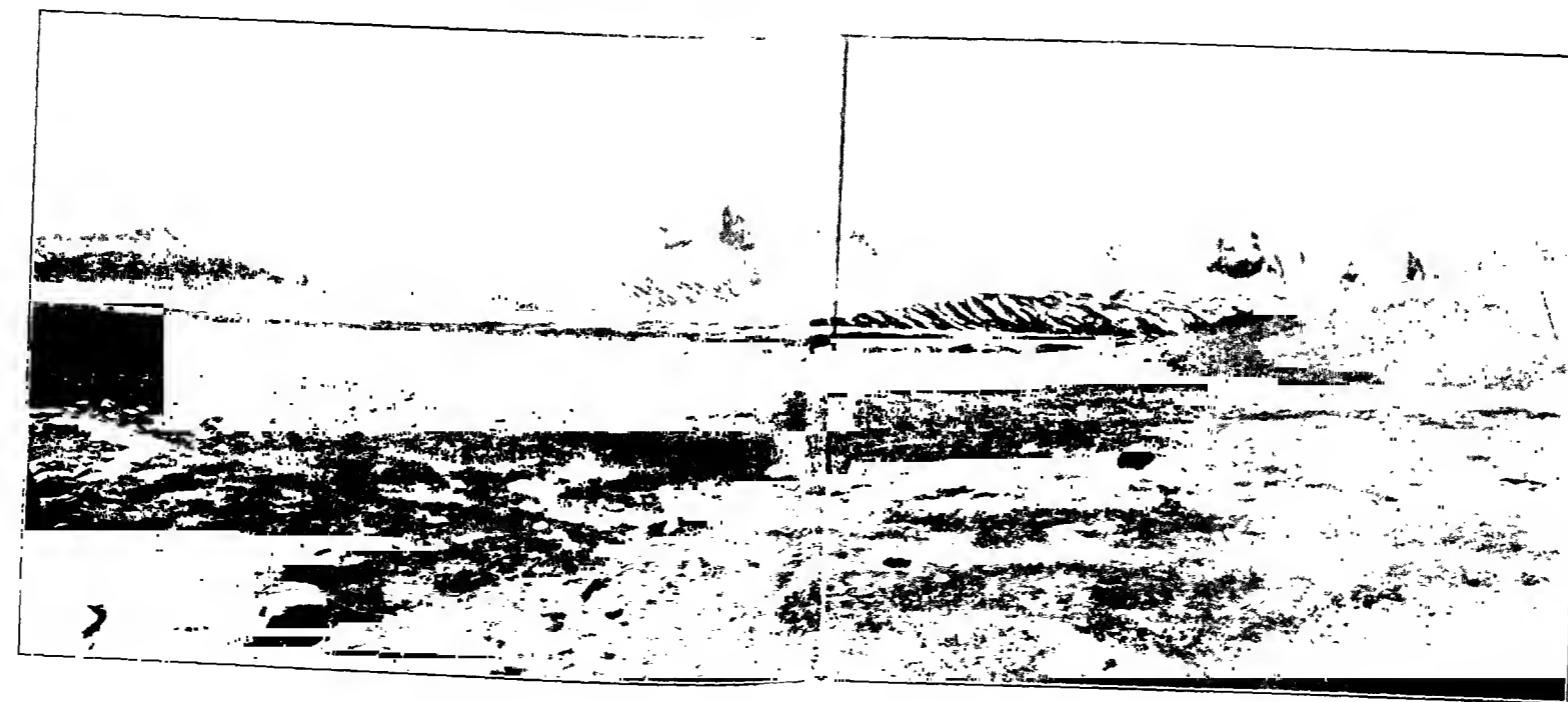
This part of N.W. Nepal, or the country S.W. of the Tibetan frontier is completely unknown and left as a blank on all maps. But from the information I got it really seems likely that there are two ranges between the Map-chu of Purang and the Kubi-tsangpo. S.E. of Gurla-mandata, Ryder has also two ranges, and this may be the case still further south-westwards. Therefore it should be possible to reach the southern side of Kubi-gangri by following the Gyang-chu upwards. This high region has many interesting problems and surprises in store for future exploration.

From Shamsang, Nain Sing's and Ryder's »furthest south«, I had now, at Camp 200, proceeded 53.2 km. or 32 miles S.W., and the general hydrographical situation had become perfectly clear to me. I decided, however, to continue in the direction of the glaciers. So, on July 12th, we marched another 16.1 km. or

¹ See p. 327.



THE KUBI-GANGRI AND THE KU-SNGO AS SEEN FROM TSONGTHI-LA.



THE KUBI-GANGRI FROM CAMP 201.

10 miles S.W. There is a road the whole way up, and at some places are marks of camps, such as fire-places, bones and skins of sheep, and rubbish. Animal life is represented by rabbits and *Arctomys*, wild geese and some kind of big water-fowls. The road is always at some distance from the river. Hard rock was seen only at one little promontory to our right, consisting of pyroxenite, plagioclas-amphibolite, and mica-quartzite, dipping 49° to the S. 80° E. On our side of the river there is a double erosion terrace, on the right side are three terraces, of which the highest seems to be some 70 m. above the present river. Sometimes these terraces may easily be confounded with moraine-formations. The terraces remain as tests of a very energetic erosive action at an earlier period. Since then the glaciers have retreated farther and farther southwards into the mountains, and the Kubi valley we see is a work of the past.

A short distance above Camp 200 the river changes its aspect altogether. It becomes very broad and divided into several branches surrounding flat islands and banks of mud and clay. The current is very slow and there is not a single rapid. Here the river cannot be crossed, as its bottom is said to be treacherous quagmire. The whole bottom of the valley is flat, perfectly horizontal to the eye; the ground is dust and clay; gravel is seen only in the beds of ravines; only one of them contained some water. Further south the ground becomes swampy and forces us to the top of the lowest terrace. This is pierced by the deep-cut valley of the brook from the Dongdong glacier, situated due west, and south of the glacier which gives rise to the Chema-yundung. At its junction with the Kubi the Dongdong brook had about $2\frac{1}{2}$ cub. m. and is therefore a comparatively small tributary to the main river. The Dongdong makes a short bend to the south before it empties its green-greyish water into the dark grey Kubi.

A round pool, surrounded by moraines, and called Tsechung-tso, is passed to our left. At rare intervals small erratic blocks of granite are passed. The ground is always comfortable and soft, glacial material. Having crossed a brook with $\frac{1}{3}$ cub. m., we reach an oblong lake, from the northern end of which the Kubi-tsangpo issues. The lake is surrounded by low rolling hills, partly moraines, partly sand dunes, most of them bound by some grass. The water of the lake has the same dark colour as the Kubi, and may in fact be regarded simply as a wide part of the river-course. The outlines are extremely irregular, and there appears between the hills a series of pools with clear water, which therefore are not in connection with the main lake. There are many islands and peninsulas of mud and sand with grass in the lake.

On the west the valley is bounded by hills some 500 m. high, here and there with stripes of snow, and ravines; on the east by a rocky ramification from the Kubi-gangri, also with snow. All this snow should disappear within a few weeks. Camp 201 is situated near a brook from the N.W., called Shapke-chu, and carrying about 2 cub. m. a second. The absolute altitude is 4,841 cm. (15,878 feet). One would have

expected a considerable rise to the snouts of the glaciers, but the valley is nearly horizontal for some 15 miles north-eastwards from the source — otherwise the lake could not have been formed without the help of a moraine-dam. At Camp 200 the height was 4,861 m. (15,944 feet), but this place is situated in the hills above the river, whereas Camp 201 is *au niveau* with the Kubi lake.

The view is brilliant. To the south are the two magnificent glaciers of Ngoma-dingding and Absi with their lateral and randmoraines and their heaps of grey terminal moraines. Between them and at their sides the black *propylaea* of the rocks rise above our heads, and still higher the summits further south like white tents. It would be hard to imagine more worthy surroundings for the source of the Brahmaputra. The several panoramas and the photos I took at different places will, together with my map, give a clearer view of the situation than any description in words. My object was only to fix definitely the situation of the source, and I had to leave the detailed glacial exploration to the future.

From Camp 201 in the Shapka region, the highest where nomads are accustomed to pitch their tents, we had still 8.5 km. or five miles to the very source, and this little bit was accomplished on 13th July. The road goes S.W., W., and W.N.W. To the right or north the hills rise more or less abruptly; they are a combination of solid material belonging to the ridge we had crossed in Tso-niti-kargang, and moraines, which have been accumulated against the sides of the hills. Only the moraines are visible; they rise above each other, sometimes with steep slopes to both sides; it is a confusion of blocks, gravel and finer material, sometimes covered and hidden by earth and dust with some sparse vegetation. At a few places where material had rushed down, the interior of the hills became visible and the moraine structure clear. No very great blocks are to be seen; the greatest measured about 8 cub. m., and at the very source was another perhaps somewhat greater.

At the foot of the moraine hills the bottom of the valley is level as before and consists chiefly of glacial clay. Tracks of wild yaks and kyangs were not rare. Several brooks come down from the hills from melting snowfields, forming pools and swamps, and continuing to the Kubi-tsangpo. These brooks are perfectly clear. The largest brook, 2 or 3 cub. m., formed a real delta with some ten branches spread over its fan. Even so late in the summer as in the middle of July the Kubi gets a considerable supply of water from the melting snow.

A river-branch with half clear greenish water finally forces us to turn W.N.W.; the colour of this water proves that it comes chiefly from snow; it has cut out a real valley between the old high moraines to the north, and the present front-moraines. Some two or three hundred metres below the front, this branch joins the several brooks which rush out from under the snout. Of the latter, two are particularly large, namely the one along the right or southern side of the valley, and the one from the middle of the snout. In the brownish grey water of these branches



A PART OF THE KUBI-GANGRI AS SEEN FROM CAMP 201

the green snow-water soon disappears. After the junction, the Kubi by no means remains one single string of water; the river again divides in several meandering branches covering the broad almost horizontal bottom of the valley. At the right or southern side of the valley there is also an uninterrupted wall of old lateral moraines pierced by ravines and partly covered with snow.

At the snout where the Kubi gushes out from under the ice the absolute height is 4,864 m. (15,954 feet), only 23 m. higher than Camp 201, and showing how extremely level the valley is from the source to Camp 200, a distance of 24.6 km. A very slow fall is characteristic for the valley of the whole Tsangpo down to Shigatse.

I climbed 150 m. up the moraines north of the snout to get a good view of the place. The slope is steep amongst blocks, gravel, snow, brooks, small pools, moss without any kind of order. There is no living rock; the moraine material consists of grey gneiss, mica-quartzite, gneiss-granite, quartzite and limestone.

From this standpoint, at 5,015 m. (16,450 feet) I drew the panorama which has been published before.¹ From the S. 55° W. the principal glacier, Langta-chen, comes down in a beautiful curve, gathering its ice from at least three different *nevées*, and with three moraines on its white surface. The moraine on the right side is well developed. The moraine on the left side is, by and by, eroded by the above mentioned green water brook, and is smaller. Only higher up, where it is not touched by the brook, it is accumulated to a considerable extent. Here it is combined with the gigantic terminal moraine of another glacier, coming down from the west. The river in this direction is, however, much hidden by ramifications and moraines.

Langta-chen is a summit between the two glaciers, and the same name may be given to the glacier at its eastern foot; the western glacier could perhaps be called the Brahmaputra-glacier. The topography of this glacial region could of course not be made out in detail from a distance, and my map is only preliminary. Future exploration will certainly show that the topography is much more complicated than on my map, which is compiled only from panoramas, photographs and bearings.

The whole snout of the joint glacier is dirty from gravel and small blocks brought down on the ice-stream. Only here and there in crevasses is the blue-green ice visible. Some small glacier-lakes stand on the ice, with turquoise-blue water; some other pools are dirty from moraine material. The moraine which is formed just in front of the snout, and where also some pools are to be seen, has no time to grow to any considerable extent, for the river, which is born here, sweeps the material away. The middle branch of the Kubi, which seems to be the strongest, comes out as through a gate between the hills of the terminal moraine.

To the south is the black rocky ridge called Mukchung-simo, which looked like two peaks when seen from Tso-niti-kargang. I wished to cross the uppermost course of the Kubi to measure its volume, but soon found that the river was absolutely

¹ Trans-Himalaya II, p. 102. Compare also the Atlas of Panoramic views.

impossible to ford; not for the water which could amount to some 10 cub.m., except the northern green coloured branch with perhaps 4 or 5 cub.m., but on account of the consistence of the river-bed. Those parts of the broad level bed which were occupied by running water were hard and could easily be crossed; but such parts which were only moist and not touched by the current were quagmires in which the ponies sank down.

After their junction I estimate the brooks, i. e. the very head of the Kubi-tsangpo, at some 15 cub.m. The river flows eastwards, and soon widens out to the long lake at the western shore of which we had our Camp 201. In the uppermost part of this lake or widening, the Kubi receives the brooks of the Absi- and Ngoma-dingding-glaciers, carrying perhaps 5 cub.m. each, making in all 25 cub.m. To this comes the amount of Shapke-chu, Dongdong-chu, and some few brooks from melting snow, and finally the brook of Lungyung, in all amounting to at least 15 cub.m. This estimate is roughly made under the influence of the measured 34 cub.m. at Shamsang. But as the river at Shamsang rises strongly towards evening and night, the above estimates are probably much too low. This, however, is not of great importance for we have already settled the problem and found that the Kubi-tsangpo is $3\frac{1}{2}$ times as mighty as the Chema-yundung and Maryum-chu together.

On July 14th the Camp was moved to the mouth of the Dongdong valley. I took the way over the hills to the west to get a last view of this wonderful place which was perhaps the most interesting I touched on the whole journey of 1906—1908. The rise is steep through ravines, amongst blocks, gravel and melting snow, three small moraine-lakes are passed, and some small brooks, and finally we reach the very top of the hills, where the view is free all round the horizon. The weather was perfectly clear, and I could take a series of photos of the Kubi-gangri which is specially important to check the panorama which I drew from the same point. The height was here 5,310 m. (17,417 feet) or 470 m. above Camp 201.

From this place the Nangsa-la was shown to the S. 50° E. If this information be correct, the Gyang-chu can hardly get any water at all from the southern side of the Kubi-gangri, which under such conditions drains only to the Map-chu. The problem can only be solved by new exploration. To the S. 27° E. is the peak Ngoma-dingding and S. 11° E. the peak Absi; the Ngoma-dingding glacier is visible between both, and the Absi glacier to the west of the Absi peak. The highest point on the Mukchung-simo ridge is to the S. 24° W.; it is situated on the west side of the Absi glacier. There are several small hanging glaciers, looking N.W., situated in the upper parts of the steep and short valleys or gorges of the Mukchung. In the background of the Langta-chen glacier, to the S. 57° W., two very flat conical peaks with eternal snow are visible; they are said to be called Langta-chen. S. 70° W. and S. 88° W. are the culminations of the massive Gave-ting. N. 55° W. are three peaks belonging to the massive Dongdong, which otherwise is hidden by hills and moraines in our neighbourhood. From this massive the brook starts, near which Camp 202 was pitched.



PANORAMA OF THE KUBI-GANGRI WITH THE SOURCE OF THE BRAHMAPUTRA. TO THE LEFT ON THE UPPER PANORAMA THE VALLEY OF THE KUBI-SANGPO IS SEEN, AND IN ITS CONTINUATION TO THE N.E. AS A HAZE FAR AWAY THE TRANSHIMALAYA. THE LOWER PART OF THE PANORAMA IS A DIRECT CONTINUATION OF THE UPPER HALF. THE PANORAMA IS TAKEN FROM A POINT ON A MORAINE WEST OF CAMP 201.

The view to the N.E. is very interesting. The straight, grey and not very deep-cut valley of the Kubi-tsangpo is seen stretching north-eastwards between ridges and ramifications; when seen from above the long Kubi lake looks rather like an alluvial plain of fine grey glacial clay, covered by very broad and shallow river-branches; perhaps it is more correct to call it a widening of the river-bed itself. Further down two or three widenings of the same kind are visible, and only below them the river concentrates itself to one narrow bed. Beyond it, in the distance, is again the flat, even Transhimalayan system with its innumerable pyramidal peaks, all of the same height like the blade of a saw: the great distance makes the different ranges melt together to one single mass of mountains.

On the surrounding heights the same specimens of rocks prevail as near the source, especially gneiss and granite; on account of the exposed situation many of the blocks are strongly windworn. From the height of the hills the slope goes very steep down amongst blocks, gravel, brooks and pools; finally the slopes become more rounded and covered with grass. At Camp 202 the height was 4,844 m. (15,888 feet), nearly the same as Camps 200 and 201.

The march of July 15th took us N.N.E. 15.1 km. Dongdong-chu now carried about $3\frac{1}{2}$ cub.m. muddier than a few days earlier. The road follows the Kubi-tsangpo at some distance over a ground full of gravel and small blocks, brooks from springs and small snow-patches, and swamps. A gradual slope takes us up to Kargang-la 5,182 m. (16,997 feet) high, and situated in the same ridge as Tso-nitikargang-la not far to the N.E. From this point the Dongdong massive appears to the S. 50° W.; to the right of it is a glacier, and W.S.W. the wild peaks of Chema-yundung-pu. Due west is another glacier, which must also send a brook to the Chema-yundung-chu. To the N. 78° W. is a snow-covered group with an abrupt promontory N. 70° W., called Dugmo-kar. N. 68° W. the country looks rather open. N. 55° W. the mountains which belong to the Transhimalaya are visible. N. 35° W. is a violet-coloured conical peak in our neighbourhood. Direct north one sees a part of the narrow passage through which the Chema-yundung flows and which is called Chema-yundung-char-bup. To the N.E. the Maryum-la is pointed out surrounded by a labyrinth of mountains in brownish, reddish and rose colours, and with hardly any snow at all towards the south. Far away N. 57° E. is the peak Lasar. A little valley goes down from the pass, in which Camp 203, Dara-sumkor, has a height of 4,931 m. (16,174 feet).

From this place our direction becomes N.N.W., and we ascend amongst moraines and, higher up, hills, where living rock occasionally crops out, serpentine of pyroxenite, green and black. On the flat pass Tugri-la, 5,270 m. (17,286 feet) high, the rock is diabas and pyroxenite. Seen from Tugri-la the Chema-yundung-pu, visible to the S. $75-83^{\circ}$ W., has a more bulky and rounded appearance. To the W.N.W. that part of the valley is seen where the Chema-yundung-chu issues from the high mountains and reaches more open ground, called Kunjung-gedok. To the N. 74° W.

is a very flat and broad part of the valley of Angsi-chu which is a tributary to the Chema-yundung, from the left, or west. To the N.W. is a mountain Lapsingava beyond which Gunchu-tso is situated.¹ To the N.N.W. are pointed out a region Nagra, a plain Ronggak-kyermok, and a lake Kuru-chok. N. 13° W. is a hill Seu-tokar, N. 37° E. the Transhimalayan valley Sabsang, said to contain the main branch of the Maryum-chu. A valley to the N.E. was called Talung-kongyok. To the N. 64° E. is a plain called Charko, below the ridge of Tugri-la. N. 70° E. a part of the broad and open valley of the Chema-yundung can be seen.

The valley going down from the pass is called Tugri-kunglung; the living rock at its sides is serpentine of pyroxenite and diabas. The valley is rich in grass, and continues N.N.E. to Chema-yundung. Leaving it to our right we ascend the little pass Seu-kamba-la, 5,056 m. (16,584 feet) high, on the western side of which the valley Seu-kamba-lungpa is directed to the north. Following it down we soon enter the valley of Chema-yundung which here is broad and flat as a plain; the river itself was spread over a bed more than 150 m. broad, but the depth was only 0.12 m. on an average, and the current amongst the gravel very slow. The greatest part of this water seems to come down from a considerable glacier situated amongst the *gangris* of Chema-yundung-pu. Seven black tents were pitched near the river. The region is called Buk-gyäyorap and the height is 4,870 m. (15,974 feet). Even here, at perhaps 12 or 15 miles from its source, the Chema-yundung flowed at a greater height than the very source of the Kubi-tsangpo, 4,864 m. (15,954 feet). Unless the current of the uppermost Chema-yundung is as slow as that of the Kubi, the source of the western river must be at a considerably greater elevation than that of the eastern. The Chema-yundung seems to be a few miles longer than the Kubi. So in length and absolute height the western branch is no doubt more distinguished than the eastern. But the volume of water is overwhelming in the latter, and all who in future see both rivers will agree with the Chinese and Tibetans, as I did, and call the Kubi-tsangpo the source of the Brahmaputra. On account of its great volume of water, provided from four great glaciers and several small ones, the Kubi has had force and energy enough to work down its valley deeper than the Chema-yundung, and this may be one of the causes of the difference in absolute altitude.

The most comfortable and shortest way to Tag-la or Tamlung-la would have been to follow the course of the Chema-yundung and its tributary Angsi-chu to the west, which would have spared us the Marnyak-la; but I had to take the longer and more difficult way to the north to reach a Camp where new guides and yaks could be had, as my men from Shamsang had to return from here. However, I could see from my road that it was easy to pass from the uppermost Brahmaputra to the uppermost Satlej without crossing any other pass than the flat and comfortable Tag- or Tamlung-la.

¹ My guides pronounced the name of the lake: Kunkyu-tso, though I have used Ryder's spelling.

Leaving the Chema-yundung we ascend over slowly rising ground to the N.N.W. To our left the two small lakes Kuru-chok are seen. The ground is sandy with some grass, here and there are erratic blocks of granite worn by ice and wind. Ronggak-chu is a little brook with 10 cub.m. clear water coming from the hills to the N.W., and directing its very winding course to the Chema-yundung. From the point where we crossed the Ronggak, the junction of the Chema- and Angsi-chu could be seen to the S. 75° W. At Tünchung, Camp 205, where the *Gor'a* of the district had his 5 tents, the altitude was 4,987 m. (16,357 feet).

On July 18th our road proceeds W.S.W. for 19.8 km. or 12 miles over a ramification from the little range on the southern side of Gunchu-tso. This ramification seems to continue to the E.S.E. between the Chema-yundung and the Ronggak-chu. The latter receives some small brooks from the north, and is called, higher up, Tünchen-chu, coming from the Tünchen valley in the N.W. Where our road crossed it 8 tents were pitched, and from this place a road goes north-westwards over Pang-la to Tokchen. The region is rich in pools and dry depressions with a bed white with salt. On our left is the region of Buka, on our right, in the broad valley to Pang-la, there are several tents and flocks of sheep and yaks. Further on, the small valleys Taktsang and Martsuk are left on our right. In the latter, 6 tents were seen; the region is well populated by nomads. Buto is a ridge south of the road, covered with some snow. A little valley leads up to the Marnyak-la pass, 5,302 m. (17,390 feet) high; the rocks consist of mica-quartzite; it is surrounded by hills partly hiding the view. To the S. 1° E. is the highest part of Chema-yundung-pu, to the S. 21° W. a more rounded *gangri* called Memo-gangri by our guides, reminding of Memo-nani or the Gurla-mandata. S. 40° W. is a deep-cut passage in the mountains, probably containing a glacier. To the S.W. is a snow-covered mount called Tsangli-gangri, and farther west the *gangris* of Angsi-dongdong. The next is Ganglung-gangri; all these are in the same range as the Kubi-gangri. To the north and N.N.E. the mountains are called Nyarek, Changsang, and Tsagre; Maryum-la, Kyärmok, and Seu-tokar are further N.E.

From the pass the slope is first slow, then steeper amongst old moraines and erratic blocks of granite, 5 cub.m. and more. The very broad and flat valley of Angsi-chu appears, not far to the south. The living rock is mica-quartzite, granite, and mica-schist. Camp 206, Loang-goa or Loang-gonga, is situated near some pools at a height of 5,036 m. (16,518 feet).

On July 19th we continued due west 21.1 km., first crossing the Loang-goa brook, which carried about 1 $\frac{1}{2}$ cub.m. a second and empties its clear water into the small lakelets round Camp 206. Leaving them it joins the Angsi-chu. The ground, old moraines, rises slowly. To the W.S.W. the Memo-nani or Gurla appears, partly hidden by clouds. To our right is the open plain or valley of the Loang-goa, which in its upper course is called Tamlung-tsangpo; immediately north of the plain is the little range which separates us from the basin of Gunchu-tso; this range

is pierced by a series of short dry and steep transverse valleys. To the south the Angsi-chu is seen coming down, — probably from a small glacier in the mighty southern range, and then turning eastwards to the Chema-yundung. The road therefore runs along the top of a series of moraine hills between two broad and flat valleys, both belonging to the Brahmaputra.

Immediately west of the uppermost Angsi-chu a little ridge of hills stretches northwards from the southern mountains. This ridge is the water-parting between the Angsi-chu, i. e. Brahmaputra, and the Ganglung-chu, i. e. Satlej. On the road it is still some distance to the water-parting, for the little oblong lake Tamlung-tso still belongs to the Brahmaputra, and at its western end a brook enters. Crossing this brook, which certainly is the westernmost tentacle of the Brahmaputra, we take the last short, somewhat steeper ascent to Tamlung-la or Tag-la, where the height is 5,298 m. (17,377 feet). There is no living rock within reach; the gravel and small blocks are granite in many varieties, and there is a good deal of sand. To the S.S.W. are the dark shoulders of Ganglung-gangri, the cradle of the Satlej, which cannot be compared in magnificence with the Kubi-gangri.

CHAPTER XXXVIII

THE TSANGPO AND ITS TRIBUTARIES AS REPRESENTED BY THE CATHOLIC MISSIONARIES AND VAN DE PUTTE.

We now proceed to consider, historically, the exploration of the tributaries of the Tsangpo above Ki-chu. It was my good fortune to survey some 5 or 6 of them, which had hitherto been partially or totally unknown. Except the Ki-chu, Shang-chu and Raga-tsangpo, nothing more was known of the rest than a few miles of their course, reckoned from the confluence. D'Anville's map and the Ta-ch'ing map are very rich in tributaries both north and south of the main river, but they are very badly drawn and in some cases impossible to identify. European maps of later years have not considered them at all, but preferred to leave the whole country north of the Tsangpo blank.

The Catholic missionaries who, either by journeys through Tibet or by prolonged stationary work in Lhasa, came so much in contact with the great river, contributed, nevertheless, very little to the knowledge of the Tsangpo and its tributaries. GRUEBER does not even mention it from his journey between Lhasa and Langur. On the map (Vol. I, Pl. XI), in ATHANASIUS KIRCHER's work¹ it is even difficult to identify the main river itself. On GASTALDI's map (Vol. I, Pl. XVII), the Brahmaputra disappears altogether. DELLA PENNA and GEORGI hardly do more than mention the existence of the Tzangc'iù.

Even DESIDERI who has given such an interesting narrative of his journey and who had better opportunity than any other European, before Ryder and Rawling, to see the river and follow its course the whole way from Maryum-la to Chetang, has very little to tell.² What he says of the Ki-chu is not easy to understand: "Lhasa is situated in the middle of a great plain, which is surrounded by high mountains from which flows a great river, that coming from the western regions, runs to the south, very near the mentioned city and afterwards takes an eastern

¹ La Chine Illustrée de plusieurs Monuments etc. Amsterdam 1670. Vide Vol. I, p. 165 et seq.

² Vide above, Vol. I, p. 276 et seq.

direction.¹ Under the heading: *Delle Barche di pelle* Desideri gives a very clever general description of the river. He is a practical man, so that the way in which the river is crossed interests him more than the river itself. And still he has much sounder views than even Klaproth more than a hundred years later. Desideri says: 'It is necessary to know that, as the whole kingdom of Thibet is mountainous, the water that comes down from the mountains is forming various rivers, but particularly forms a principal river, which, from the western regions, is running towards the east and is flowing through the whole of the third Tibet, in the middle of it; and after having crossed the province of Kong-bò, which is further east, it penetrates through the countries of the Lhobàs, and from there descends to Rangmati, a province of Mogol; from there it goes to Ganges, in which this principal river of Thibet finally comes to an end. Although the Thibetans have, in some places, big ferryboats of wood for crossing this river, still they use as a rule hide-boats. Such boats are not of an acute form, but of the same breadth all over, and in the bottom they are flat, in which way they do not sink into the water, but keep floating on the water, and thus are very easy to turn round. Ordinarily they are composed of 3 or 4 yak hides, sewed together, and which remain stretched and convex in the bottom, by help of some bowed laths.'² In the same detailed and correct way he describes the chain bridges over the river.

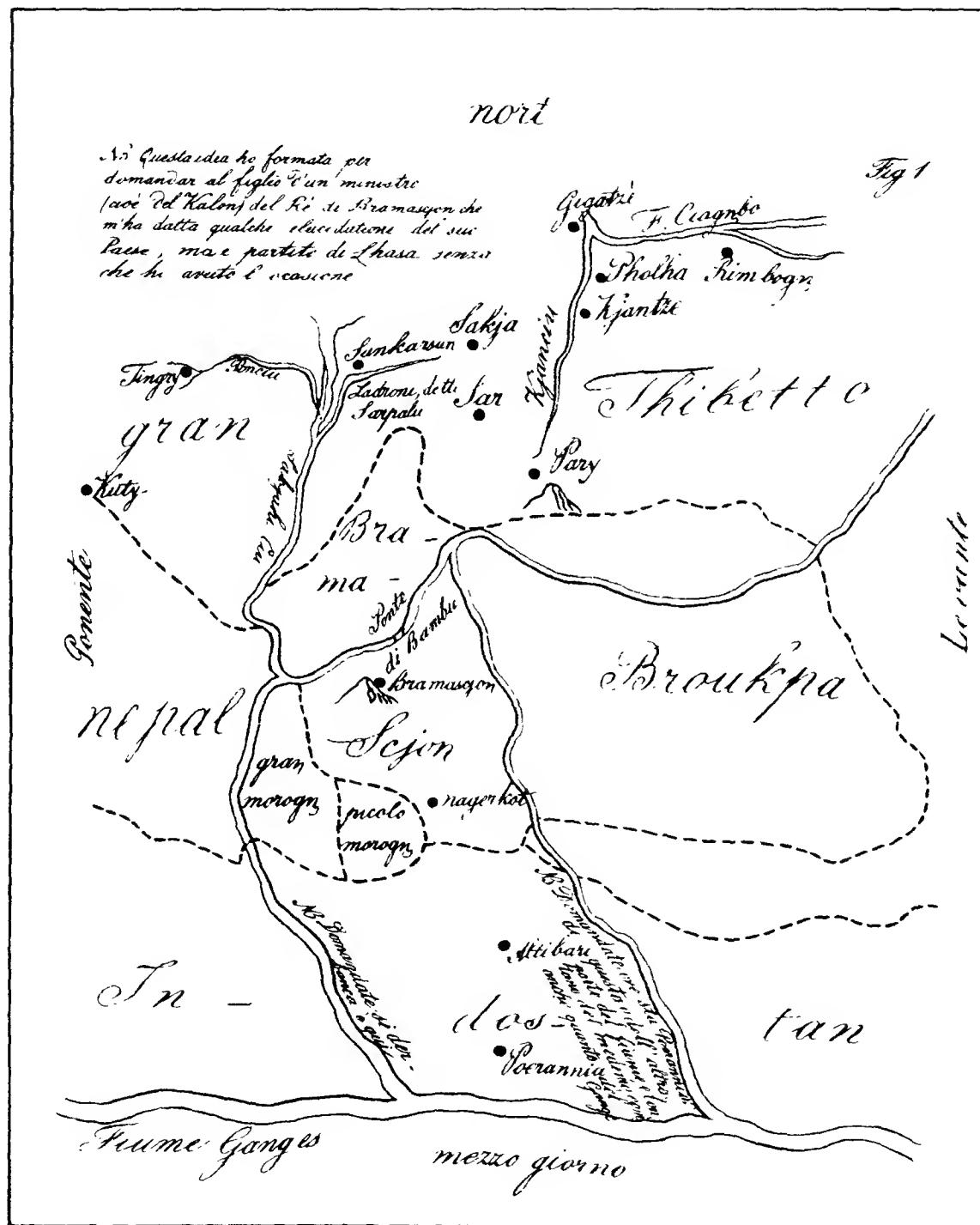
On his journey from Nepal to Lhasa Father BELIGATTI came to Tingri.³ There he mentions 'a river flowing from west to east', which is of course the Tingri-chu, a tributary to the Arun. He followed the river several days and observed how it grew bigger. Finally he crossed it on a bridge. He calls it Bontsutsambo, which MAGNAGHI identifies as the Phungtu of Stieler and the Poùmtsouk-Zzango-tsiou of Klaproth. The same river is called Ponciu on van de Putte's sketch-map. Later on, beyond Gyangtse, he mentions "the river which goes to Kiansè", which is Nyang-chu. Then Beligatti says: »The morning of the 3d (January 1741) we descended still a little, and entered the valley through which passes the river Tzanciù which we had seen from the height of the mountain of Kambalà; we travelled on the bank of this river for a distance of 3 kos, sometimes rising, sometimes descending between great blocks, and finally arrived at the place of the boat, on which one has to cross the river to the other bank.»⁴ Then follow some curious statements: »The river Tzanciù descends precipitously from the height of a broad ravine in the mountains N.E. of Lhasa; the head of the river is about a kos further north from the city, and, following the foot of the mountains, the river suddenly becomes great and rapid and it runs a long way south, at the foot of the mountains.» He describes the canals from the

¹ Il Tibet etc. ed. C. Puini, p. 54.

² Ibidem p. 100. Compare with this description of the boats the following: »A skeleton, or rather framework, of thin tough boughs and laths is tied fast together, and is covered with four yak hides sewed together, which are attached to a rim . . .» Trans-Himalaya, I. p. 288.

³ Relazione inedita di un viaggio al Tibet . . . A. Magnaghi. Firenze 1902.

⁴ Op. cit. p. 66.



Van de Putte's map of a part of Southern Tibet.

river, in Lhasa. The bed of the river has more than 30 feet elevation above the level of the city. Then follows the description of the boat for 15 or 16 persons and how it is kept against the current by help of ropes. And he describes the chain bridge and how it is used. Everything in the narrative points to the Tsangpo and not to the Ki-chu, especially as he says that, the next day after the crossing of the Tzanciù, he had the river to his right, on the way to Lhasa. As Magnaghi says, Beligatti has confounded the Ki-chu with the Tsangpo. The Father must have forgotten the whole situation when he took down his notes. Or, perhaps, he was so interested in observing the hide-boats, that he never saw how the river comes down from the west. When he afterwards continued to Lhasa he confounded the whole situation and got into his head that the whole river came from the N.E. and that Ki-chu was the upper part of the Tsangpo. Such a mistake may be made if the observer is not attentive or if the weather is bad.¹

On SAMUEL VAN DE PUTTE's sketch-map in the museum of Middelburg, embracing a part of Hindustan north of Ganges, eastern Nepal, Sikkim, Bhutan and a part of Southern Tibet, south of Tsangpo, we find an interesting little bit of the Tsangpo, Pl. XX. The editor, Prof. P. J. VETH, says in his text:² »On van de Putte's map she (the Tsangpo) is only represented from Shigatse, which is situated near the point where a tributary, called Kjanciu by van de Putte» joins her. Veth believes this is correct, but that the river ought to come from the S.E., as is indeed the case, and not from the south as van de Putte has it. The hydrography, so far as it is visible on the map, is not so bad, however, for we have the F. Ciangbo from Gigatzè and eastwards beyond Rimbong,³ as well as two tributaries: the Kjanciu (Nyang-chu) with Kjantze (Gyantse) on its right bank, and the little river which comes from the mountains on the west shore of the Yamdok-tso and flows W.N.W. Shigatse is also correctly placed as compared with Tsangpo and Nyang-chu. Tingri and Ponciu and Sakja are also rather good. His Sunkarsun may be Shikar-dzong. As van de Putte crossed Tibet diagonally from India *via* Lhasa to Peking and back the same way, he could not possibly know anything more of the Tsangpo than the part he has represented on his map.

¹ Della Penna describes the place thus: «La capitale di questa provincia d'U è Lhasà, e vicino a questa città passa il fiume detto Tsangiù che ha la sorgente sopra a Sciarbigonti, ed entra nel fiume Ciasum, vicino alla fortezza detta Cuciur, tre giornata lontana da Lhasà». To him the river of Lhasa is the Tsangpo which joins the river of Chaksam at the ferry and near Chushul.

² »De Nederlandsche Reiziger Samuel van de Putte.« Tijdschrift van het Aardrijkskundig Genootschap, Deel II, No 1, Amsterdam 1876, p. 5 et seq.

³ Rincpou on d'Anville's map.

CHAPTER XXXIX.

BOGLE, TURNER AND MANNING.

GEORGE BOGLE, who travelled in 1774—75, was, together with his companion, Dr. HAMILTON, the first Englishman to cross the Tsangpo. Concerning this river and two of its tributaries (Nyang-chu and Shang-chu) he gives some information in his diary.¹ With regard to his approach to the great river he says: »A stream of water falls from the Sham-chu into the Calo-chu Lake,² which extends about ten miles east and west. A large village, named Caloashur,³ stands upon the bank of it, and another stream runs from it northwards.⁴ We kept close to this stream for several days: it falls into the Tsanpu Shigatzé, turning many mills on its way . . . There are also several bridges on this river . . .» He arrives in Giansu,⁵ which, »on the west is washed by the river». Proceeding on November 5th he found the river considerably increasing. After having followed the ordinary road towards Shigatse for several days, he turned to the right crossing the hills between the Nyang-chu and the Tsangpo: »After passing the valley we had to ascend some hills by a difficult and stony path, then to descend, and then ascend again, after which we had a view of the Tsanpu, running eastwards.» Then: »On the 7th of November, after descending an easy hill, we arrived on the banks of the Tsanpu. It is here about the breadth of the Thames at Putney. The channel is not fordable.» He describes the ferry-boats and hide-boats. »After crossing the river, we rode northwards over a large sandy bank, which is overflowed in the rainy season, and entered a valley which opens upon the Tsanpu.» He continued up this valley in which a rivulet was running. The valley and the rivulet he calls Chamnamring⁶ from the place Nam-ling-dsong. Its real name is Shang-chu. On his way back he crossed the Tsangpo near Shigatse.

¹ Published by Sir Clements Markham in his »Narratives of the Mission of George Bogle to Tibet and of the Journey of Thomas Manning to Lhasa«. London 1879 (Second Edition), p. 73 et seq.

² The Rham or Bam Tso and Kala Tso of Ryder's map.

³ Chalu of Ryder's map.

⁴ That is Kiang Lope Chu and its main river Nyang-chu.

⁵ Gyangtse.

⁶ Chamnamrim on d'Anville's map, identical with Shang-nam-ling.

SAMUEL TURNER on his mission to Tashi Lama in 1783—84 did not even reach the Tsangpo, although he saw the river at a distance. He followed the same way as Bogle »through the valley of Jhansu» as he calls Gyantse. He found it »extremely rich with abundant crops of ripe corn, and exceedingly populous». He ascended the rock of Teshoo Loomboo and gives the following description of the view he had from its top: »From hence, I had the satisfaction to observe, on the northern side, at the base of the rock on which I stood, that celebrated river, the Berhampooter, in the language of Tibet styled Erechoomboo. It flows in a wide extended bed, and, as though the soil gave it an unwilling passage, it has forced itself through many channels, and formed a multitude of islands in its way. But though its bed appears so wide extended from hence, I was told, that its principal channel is narrow, deep, and never fordable. At this place, it receives the tributary waters of the Painomtchieu,¹ which I traced from its source, soon after my entrance into Tibet, to this termination of its course. Its individuality and its name, are here lost in association with the superior body, like various other streams, which come both from the north and from the south, and contribute to the magnitude of the Berhampooter, before it passes Lassa, and penetrates the frontier mountains, that divide Tibet from Assam. In this latter region, it receives a copious supply, from the sacred fountains of Brahma-koond, before it rushes to the notice of Europeans below Rangamatty, on the borders of Bengal, where it becomes a mighty river, exceeded in size by few that are yet known in the world. From hence it hastens on to meet its sister stream, the Ganges. These far-famed rivers are nearly related in their birth, as well as united in their termination . . . Having now conducted the river, on which I looked down, to the termination of its course, I must not take my leave, without paying some further respect to this distant traveller, and marking, at the same time, the veneration attached to these celebrated sister streams, the Berhampooter and the Ganges. The common source of both, is the lake Maunserore;² situated, as I was informed, a month's journey north-west from Teshoo Loomboo. Separating at their origin, they flow in nearly opposite directions, one towards the east, the other to the west. It is the fate of the Berhampooter, to penetrate, in a tortuous course, a rude climate and most stubborn soil, till at length it quits Tartary and forcing a passage through the frontier mountains of Assam, enters the eastern boundary of Bengal.»³

This is a good general description of the river. The statement that both the Brahmaputra and Ganges rise from the Manasarovar is probably influenced by Tieffenthaler and Anquetil du Perron, although it is also, as we have seen, a general oriental view. Turner's map is very good, and for the time at which it appeared, admirable.

¹ Nyang-chu.

² Manasarovar.

³ »An Account of an Embassy to the Court of the Teshoo Lama, in Tibet . . .» London 1800, p. 297 et seq.

A record of barrenness and ignorance is the diary of THOMAS MANNING of his journey to Lhasa in 1811—12. Therefore the feat, in itself remarkable, loses all its importance and interest. He hardly mentions the tributaries and has never heard the name of the Tsangpo. He talks of a »lake or see« which seems to be Bam-tso. »We proceeded on to where the lake becomes a river, in a narrow pass between the brown, dry mountains; here it was open in the middle, and running briskly.» Then he observes a stream flowing in the middle of a valley, probably the Kiang Lope Chu. He observed »the river, which flowed through the valley towards Giansu». He confounds the Tsangpo and the Ki-chu just as Beligatti did. At least he says, when he comes down to the valley of the Tsangpo: »We were now in the valley in which the town of Lhasa stands, distant from it about fifty or sixty miles . . . The valley was wide, a lively stream flowed through it, houses and villages were scattered about, . . . we descended down to the sandy shore, and found a large and good ferry-boat ready to waft us over the stream, whose width here was considerable.»¹ The lively stream was the great Tsangpo or Brahmaputra. There is no other hydrography in his narrative, which is very meagre when compared with the important knowledge so often brought to us by oriental writers.

The fact that HUC has nothing to say of the Tsangpo is easy to understand, as he never touched the river. It is more curious that he has no details about the Ki-chu.

¹ Narratives of the Mission of George Bogle to Tibet . . . etc. By Clements R. Markham, p. 213 et seq.

CHAPTER XL.

NAIN SING AND THE TSANGPO.

We have dealt with NAIN SING's survey of the sources of the Tsangpo.¹ Some 40 miles S.E. of Tamjan he crossed the first large tributary, Chu-Nago, which comes from the north; intermediately only two small tributaries were noticed.² From Chu-Nago the Tsangpo was found to flow S.E. and 50 miles lower down it received a large tributary, Chachu Sangpo, coming from the north; it was about 200 paces wide, »and not very much inferior to the Brahmaputra itself».

From Chachu the Tsangpo is said to flow 4 or 5 miles due south, then it continues S.E. for 30 miles, makes a great bend to the south, receives the Shorta Sangpo from the southern mountains, and, after having turned N.E. again, receives the Charta Sangpo, which, in October, was some 250 paces broad, while its tributary, the Chaka Chu, was 150 paces broad. The combined Charta Sangpo was one of the largest, if not the largest of all the tributaries he saw. In May it was very slightly swollen and had ice clinging to the edges.

From here the Tsangpo was observed to flow some 40 miles a little south of east. Thence to a point above Lhatse-dsong, Nain Sing left the Sangpo. This bit of about 100 miles remained unknown until RYDER mapped the course some 40 years later. Near Lhatse-dsong, his Janglache, the Tsangpo flows N.E. to meet »a very large river, called the Raka Sangpo. Nain Sing followed the Raka Sangpo from the Gur-la to Nabring lake. »At this place it was a large river, but when seen again lower down, at its junction with the Brahmaputra, the Raka Sangpo had become very much larger, having evidently received a large addition by one or more tributaries from the north.» Its breadth was estimated at 200 paces. From here his companions took boat to Shigatse, while Nain Sing himself followed the southern bank of the Tsangpo, »crossing a good-sized tributary from the south. Sometimes he could see

¹ Page 233 above.

² Report of a Route-Survey made by Pundit *— from Nepal to Lhásá, etc. by Captain T. G. Montgomerie, Journal Royal Geogr. Society Vol. 38, 1868, p. 129 and 211 et seq.

the Tsangpo from his route. »From Shigatze the great river is again visible at the point where it receives the Penanangchu River¹ from the south.» This was about 150 paces wide in December. Next time he saw the Tsangpo was at Khambabarche, where he crossed it to Chushul. »From Chushul the Pundit could see the river flowing eastward for 20 or 30 miles, and was informed that it continued to flow in that direction for a great distance.» Finally he says that the Kichu Sangpo is navigable for small boats for about 30 miles, and in January was about 250 paces wide.

Regarding the colour, the Pundit made the following observations: ² »At Chushul, 585 miles from its source, the water of the Brahmaputra was in January very clear, and again in April at the same point the water was only slightly less clear, though the river had swollen. As to the tributaries, the water of the Charta Sangpo and the Chaka Chu rivers was very clear in October, and in May, after the river had swollen, the water was still only slightly less clear.» The Raka Sangpo was very clear in October. From the qualities of the water, MONTGOMERIE draws the conclusion that, as the four northern tributaries were clear, they could not come from glaciers, or, if they did, the glaciers must be very remote or very small. For at the time of Nain Sing's journey nothing was known of the mountains to the north. His conclusion is partly correct, for even the glaciers of the Lunpo-gangri are small, although they are not remote.

Nain Sing reported that »the main river below Tadum (Tradum) is never fordable, even at the broadest part.³ A few pages further on, Montgomerie says: »The river is nowhere fordable from its source to near Lhasa.⁴ Only the first statement is correct, for between the source and Tradum I passed two fordable places of the Tsangpo. The six great tributaries Nain Sing passed he found to be rapid, deep streams, »that are not fordable during summer, and only one or two can be crossed with difficulty on large horses and yaks when the rivers are low, at other times they are invariably crossed by means of boats». This is no doubt generally correct, although the Chaktak (Charta)-tsangpo in the beginning of June 1907 could easily be crossed even by small ponies and mules.

Referring to the main river Montgonerie says: »After receiving so many large tributaries, it may be a matter of wonder that the river was not broader, but that it should not be so is quite in accordance with what is known of the upper course of the River Indus, which rises not far from the Mansarovar Lake, and flows through the same style of country as the Brahmaputra. He believes that the six tributaries of the Indus, Zanskar, Dras, Saoroo, Shayok, Gilgit and Caubul rivers, are not equal to the six tributaries of the Brahmaputra above Lhasa, as described by Nain Sing.

¹ The Nyang-chu, Painom-tchieu of Turner.

² Loc. cit. p. 213.

³ Loc. cit. p. 214.

⁴ Loc. cit. p. 219.

Therefore, he says, the Brahmaputra below Ki-chu must at least be equal to the Indus at Attock. Here he makes a mistake. The country through which the upper Indus flows cannot be said to be like the country of the Tsangpo. It gets less precipitation and is generally drier. The mountains are lower. The distance to the Himalayan foot hills is shorter. Therefore more of the humidity of the ocean is stopped before it reaches the mountains round the upper Indus. The upper Tsangpo therefore receives more water and its tributaries are much greater than those of the upper Indus. But none of them, not even Raga-tsangpo, can be compared with the Shayok. For further west the precipitation again gets much more abundant. I should think that the Shayok, in summer, is several times bigger than the Raga-tsangpo. Montgomerie goes so far as to make each of the Tsangpo's six tributaries larger than the Ganges at Hardwar, and thus he gets for the whole river, below Ki-chu, a volume of 35,000 cubic feet per second, during the dry season, December and January. As Montgomerie calculates an average of some 5,000 cubic feet for every tributary, he gets 20,000 cubic feet for the Tsangpo just below the junction with the Chaktak-tsangpo, — during the dry season. How very vague and uncertain such calculations are may be seen by the fact, that at this very place the river, after having received the Chaktak-tsangpo, carried only 3,196 cubic feet on 29th of May 1907.

On the admirable and historically important map compiled by Montgomerie from Nain Sing's report, all the six large tributaries and several small ones are entered so far as Nain Sing could make out their course. We have first the Chu-Nago coming from the north. Then the Chachu Sangpo, coming from N.N.E.; there was a ferry-boat where the *tasam* crosses it. The real name of the river is Tsa-chu-tsangpo. The river of Nyuku he calls Minchu Sangpo; I heard it as Men-chu. Then follows the Charta Sangpo from N.N.E., receiving the Chaka Chu. The latter name probably comes from Saka, a place situated on this river. Nain Sing's Charta is the same as my Chaktak; if the name is quickly pronounced it may easily be misheard. The Shorta Sangpo is also entered on Ryder's map, where its lowest part crosses the Shote Tang. Raka Sangpo (Raga-tsangpo) is by far the best mapped of all the tributaries, as the route of the Pundit followed almost the whole course of this river. Both the Raga-tsangpo and its surroundings had indeed to be rediscovered by a trained surveyor, for here the Ta-ch'ing map was very wrong, and d'Anville's map still worse. And here Nain Sing really improved the Chinese map, which, as we have seen, cannot be said of his survey near the source. Only in one detail is his map of the Raga-tsangpo inferior to the Chinese, for he has not a single northern tributary, whereas the Chinese map, correctly, has three. Nain Sing also mapped in the two small lakes Nabring Kimcho and Lang Cho Gonak, both of which were on the Ta-ch'ing map more than a hundred years earlier, the first called Ghiit ghia mtso with, at its southern shore, a place called Djang abring (Dsong-nabring?), — and Long tso.

The Nyang-chu had been better mapped by Turner, 80 years earlier, and the Ki-chu was on d'Anville's map called Kaltiou R., and much improved by Nain Sing.¹

Desideri's precious manuscript was not yet known. But the Ta-ch'ing map existed. The main Tsangpo and everyone of its tributaries were mapped. The sources of the Brahmaputra were incomparably better surveyed by the Chinese than by the Pundit. So far as the course of the Tsangpo is concerned everything was known before and the Pundit made only a few discoveries of snowy mountains to the north, which are hardly possible to identify from any earlier map. He travelled in the easiest and most comfortable part of Tibet, along the *tasam* which was, of course, the first and most important line already for the Chinese surveyors to follow. And still the Pundit's merit is enormous, as the Chinese statements had to be controlled and all geographical co-ordinates fixed. Thus his journey always remains, from a geographical point of view, an epoch. The next step should be a complete exactness and precision, carried out by triangulation and with that task Ryder's and his comrades' names are for ever associated.

But in order to make real geographical discoveries Nain Sing had to direct his attention further north as he did on his great journey between Leh and Lhasa. In the whole interior, north of the Tsangpo, only a few lakes and one or two rivers of the Chinese map may be identified, although the situation is here erroneous. As to the mountains they are completely useless all over the Chinese map. But the highest class of fresh discovery was only to be made in those parts of northern Tibet where PRSHEVALSKIY, A-K-, BOWER, WELLBY, LITTLEDALE, BONVALOT and myself have travelled, for those parts were left blank on the Chinese and all other maps.

¹ The enthusiastic Petermann says of Nain Sing's journey that it »zu den staunenswerthesten Thaten gehört, welche die an kuhnen und abenteuerlichen Reisen so reiche Entdeckungs-Geschichte Inner-Asiens zu verzeichnen hat. Mögen uns Muth und Ausdauer eines Antonio de Andrada imponiren, der 1625 von Kaschmir (!) aus zu Fuss und ohne Fuhrer, nur von zwei Knaben begleitet, die öden Schneegebirge nach dem oberen Setledsch überschritt, oder eines Pater Desideri, der 1715 von Kaschmir durch das nördliche (!), seitdem nicht wieder betretene Tibet nach Lhasa gelangte, oder der Patres Grüber und Dorville, die 1661, und der Lazaristen-Missionäre Huc und Gabet, die 1845 bis 1846 von Peking über Sining und die Gebirgsketten des nordöstlichen Tibet, vielleicht die höchsten der Welt, unter furchtbaren Anstrengungen Lhasa erreichten, aber keinem von ihnen steht der junge brahmanische Schriftgelehrte (Pundit) nach . . .» Petermann's Mitteilungen 1868, p. 234.

CHAPTER XLI.

THE PUNDITS AND THE TSANGPO-BRAHMAPUTRA PROBLEM.

The names of several Pundits are also associated with the desperate attempts to identify the upper course of the Brahmaputra.

We have seen that DU HALDE believed the Tsangpo were the same river as the Brahmaputra for he says: »Il est vraisemblable qu'il coule vers le Golphe de Bengale: car du moins on sait sûrement que des limites du Thibet il va Sud-Ouest à la mer, & que par conséquent il coule vers Aracan, où près de l'emboûchure du Gange dans le Mogol, que les Thibetains nomment Anonkek ou Anongen.¹ DESIDERI knew that the principal river of Tibet comes to an end in Mogol where it meets the Ganges.² To DELLA PENNA, BELIGATTI, and all the Capuchin missionaries in Lhasa the same fact was well known, and GEORGI says of the Tsangpo: «se tandem in Gangem exonerat.³ TURNER tells the same story in plain and clear words. The whole hydrographical situation was well known to the Tibetans. But, as RICHTHOFEN remarks, before the real hydrography was accepted in Europe, long phases of erroneous opinions had to be gone through.⁴ On his map of 1751 d'ANVILLE had joined the Tsangpo with the Irrawaddi. To this Major RENNELL makes the following very clever remark, founded on researches on the very spot:

»The Sanpoo, or Thibet river, was supposed by M. d'Anville to be the same with that which is called, in the lower part of its course, the river of Ava: but we have now little doubt of its being the same with the Burramooter, which enters Bengal on the north-east, and joins the Ganges near the sea. It was traced by me in 1765, to about 400 miles above the conflux; that is, as high as the latitude of 26°, longitude 91°; where the Bengal districts end, and those of Assam begin: but I was not permitted to go any higher . . .

¹ Description de l'Empire de la Chine IV, p. 471.

² See above p. 268.

³ Alphabetum Tibetanum, p. 343.

⁴ China III, p. 380.

The Assamese informed me, that the Burrampooter has a very long course previous to its entering Assam; and that it comes from the N.W. thro' the Thibet mountains. . . . These facts, together with those respecting the Ava river and Nou Kian, establish (I think) the strongest presumptive proof possible of the Sanpoo and Burrampooter being one and the same river, under different names . . .¹

In a letter to A. M. Delisle dated Peking, November 3rd, 1755, Father GAUBIL says: »M. d'Anville a raison de faire passer par Ava la grande rivière Yalou tsang pou, qui vient des pays à l'ouest de la source du Gange, et passe ensuite par le Tibet: cela est certain. But he does not say why he is sure of the correctness of his statement.²

On DALRYMPLE's map of Burma the Tsangpo joins the Irrawaddi, whereas the Brahmaputra is short and cut off. On his journey to Ava in 1795 SYMES found that the river which comes down from Tibet and which was supposed to be the Arracan River, was really the Kienduem, the great western branch of the Ava River.³

Rennell became the leader for the English cartographers in the Tsangpo-Brahmaputra problem. Richthofen relates how Rennell's view was confirmed by the researches of WILCOX, BURLTON and BEDFORD, 1823—28, and how RITTER brought together and discussed the whole literature of his time regarding the problem, without being sure as to which view was the right one.⁴

KLAPROTH says of Rennell that all the facts he quotes are correct but that his conclusions are false, and that those who so far had accepted d'Anville, now went over to Rennell's side and joined the Tsangpo with the Brahmaputra. On the maps in his Atlas: *Tableaux Historiques de l'Asie*, published in 1826 Klapproth himself had, however, adopted Rennell's view, for there we read the following legend to the river: »F. Yarou dzangbou ou Bourampoutra». But on these maps the geography was not the principal thing. In fact Klapproth was, already in 1825, persuaded that the Tsangpo and Brahmaputra could not be the same river. In March 1825 he drew a map where the Irrawaddi is the continuation of the Tsangpo.⁵ Two years afterwards he says: »En résumé, le Yærou dzangbo tchou ou le Grand fleuve du Tubet, qu'on avait regardé comme étant la partie supérieure du Brahmapoutra . . . se réunit, au-dessus de la ville de Bhammo, à une autre rivière considérable, venant du nord, et forme l'Iraouaddy qui passe devant Amirapoura, et va se jeter

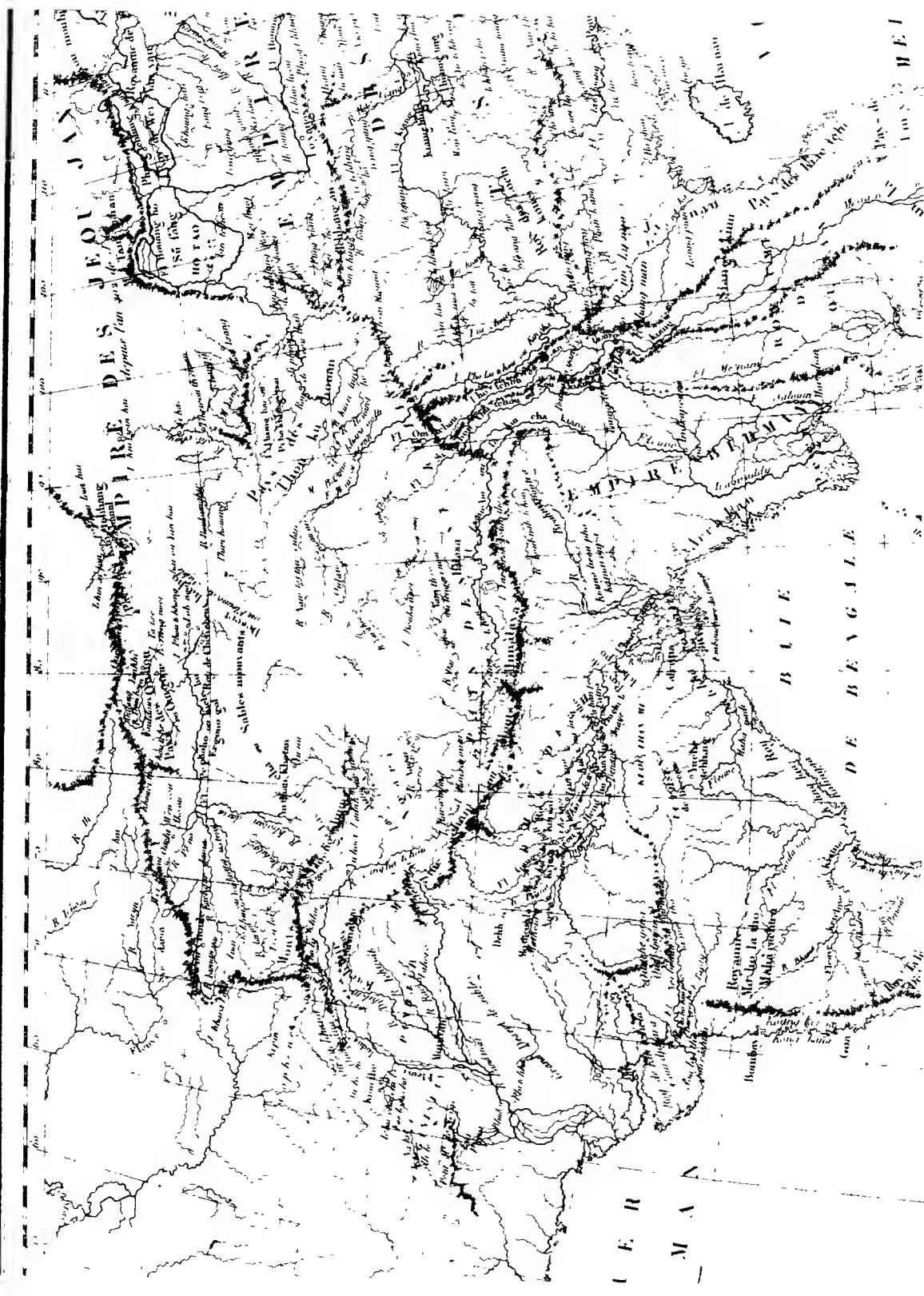
¹ Memoir of a Map of Hindoostan etc. Second Edition. London 1785, p. 95.

² Nouveau Journal Asiatique, Tome X, Paris 1832, p. 401.

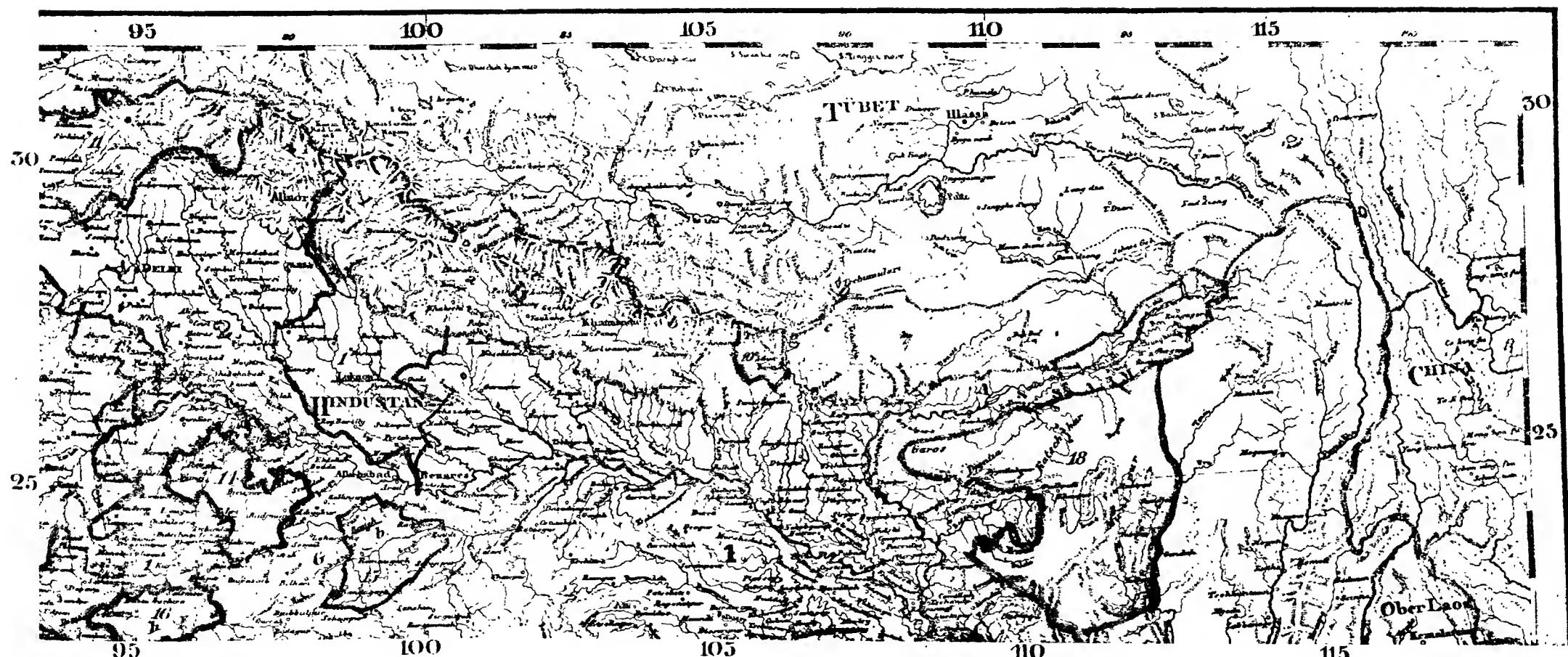
³ Reise des brittischen Gesandten Herrn Michael Symes nach dem Königreiche Ava im Jahr 1795. Übers. von M. C. Sprengel, Weimar 1801, p. 129.

⁴ China III, p. 381; Ritter: Asien, Bd III, p. 356 et seq.

⁵ He says: J'ai composé ce mémoire et la carte qui l'accompagne au mois de mars 1825, dans le moment même où le lieutenant Burlton, occupé de lever le cours supérieur du Burrampouter, reçut l'avis important, que ce fleuve avait sa source au sud des hautes montagnes de neige qui bordent le Tubet au midi, et qu'il ne pouvait être identique avec le Yarou dzangbo tchou. — Magasin Asiatique ou Revue Géographique, etc. Tome I, N:o II, Paris 1826, p. 302.



Klaproth's view of the Tsangpo-Brahmaputra-Irrawaddi problem, 1835.



H. Berghaus' map of 1834.

dans le golfe du Bengale.¹ He has been lead to this conclusion by the Chinese authours.

He also quotes two letters from Father Gaubil to G. Delisle, 1754 and 1755, where it is said: »La distance du mont Cantisse (Gangdis ri ou Kailasa) à la ville de Giti et à l'embouchure du Ma tchou a été bien prise . . . Je vous ajoute que la grande rivière qui prend sa source assez près de celle du Gange,² et traverse le Thibet sous le nom de Yarou tsampou, après être entrée dans le pays d'Assem, va aux pays de Tcha chan et de Li ma, de là au pays d'Ava, et de là à la mer . . . — M. d'Anville a raison de faire passer par Ava la grande rivière Yarou tsampou, qui vient du pays où est la source du Gange, et passe ensuite par le Thibet. Cela est certain.»

Further he quotes, from Emperor Kang Hi's ordonnance of 1721, which contains a description of the courses of the great Chinese and Tibetan rivers, amongst other passages the following: »Il y a encore une autre rivière qui passe par l'extrême frontière de Yun nan, c'est le Pin lang kiang (fleuve de l'Arec.) Sa source est dans le Ngari ou Ari, province du Tubet, à l'est du mont Gangdis, sur le mont Damdjouk kabab, c'est-à-dire bouche du cheval. Ce fleuve reçoit plus bas le nom de Yæröu dzangbo; il coule généralement vers l'est, . . . se dirige au sud; . . . et entre dans le Yun-nan . . . Il quitte cette province . . . et entre dans le royaume de Mian tian.

And finally, where the geography of the dynasty of the Thang deals with the river of Ava (Mian), the publishers have added: »Il n'y a aucun doute que ce fleuve ne soit le Yæröu dzangbo du Tubet. On his excellent map, illustrating the article in »*Mémoires*», *Carte du cours inférieur du Yarou dzangbo tchou*, Klaproth gives the lower course of the river the following names: Grand Kin-cha-kiang, Fleuve à Sable d'Or, Pin-lang-kiang ou Bammo, and, finally, Irrawaddy.³

J. D. HOOKER, who in 1848—50 went up through Sikkim, correctly says of the »Yarou Tsampoo» that it is »the Burramooter of Assam, and no one doubted this in Tibet. And further: Of the Yaru river at Jigatzi, which all affirm becomes the Burramooter in Assam, I have little information to add to Turner's description . . .», and in a note he adds: »The concurrent testimony of the Assamese, that the Dihong is the Yaru, on its southern course to become the Burramooter, renders this point as conclusively settled as any, resting on mere oral evidence, is likely to be.»⁴

Richthofen gives some examples of the great confusion brought into the hydrographical problem by German geographers, specially HEINRICH BERGHAUS.⁵

¹ Mémoires relatifs à l'Asie, Tome III. Paris 1828, p. 386.

² Here Klaproth has the note: »C'est-à-dire du Setledj.»

³ On Klaproth's and Berthe's map of 1835, published a year later in Foë koué ki we get an idea of Klaproth's view regarding the continuation of the Tsangpo. See Pl. XXI.

⁴ Himalayan Journals, London 1854. I, p. 299, II, p. 271.

⁵ Op. cit. p. 381. Pl. XXII shows a part of Dr. H. Berghaus' map, Vorder-Indien oder das Indo-Britische Reich, in Stieler's Hand-Atlas, N:o 44 b, Gotha, Justus Perthes, 1834. He gives place to both opinions: Verbindung nach Wilcox, and Verbindung nach Klaproth. He seems to regard the latter as more reliable.

HERMANN SCHLAGINWEIT regards the Lohit as the main river, and he says of the Dibong: »er mündet nicht ganz unmittelbar in den Hauptstrom Brahmaputra, sondern er ergießt sich in den östlichsten der Arme, in welche der nun folgende Strom hier sich theilt. Dieser ist der grosse Strom des östlichen Tibet, der Tsangbochú oder 'das reine (heilige) Wasser' der Tibeter; bei der Assamesen wird er Dihóng genannt¹ KIEPERT, STIELER, PETERMANN followed the same way, and for a short time TR. SAUNDERS could not resist such eminent authorities. To their speculations Richthofen remarks that this fantastic representation which had no foundation whatever had for 30 years dominated the leading and most important cartographers.

Though Saunders was, until 1874, on the wrong side, misled by mere speculation, there were geographers wise enough to consult only reliable exploration, so far as it reached. In an article: *The Irawady and its sources*, Dr. J. ANDERSON says: »I am no disciple of the theory that the Sangpo is the Irawady, and, in view of Turner's account of the Sangpo and the accurate observations made by Captain Montgomerie's pundits, I cannot see how it is possible, at the present day, that anyone could be found prepared to re-advocate its claims.²

GODWIN-AUSTEN was of opinion that neither Lohit nor Dihong were the upper course of the Brahmaputra, but the Subansiri, the temperature of which, at the junction, is lower than that of any other tributary. This theory was proved to be wrong, by the expedition of Captain R. G. WOODTHORPE and Lieut. HARMAN during the winter of 1877—78. The volume of the Subansiri was found to be only $\frac{1}{4}$ of that of the Dihong, which thus tends more than ever to identify the latter with the great river of Tibet.³

On November 30th, 1874 NAIN SING crossed the river at Chetang after his great journey through Tibet. He had seen the course of the river for a distance of about 30 miles below Chetang, and he had been informed that it flowed S.E. into Assam. At Chetang he describes the Tsangpo thus:

»The valley through which the river flows was here several miles across; on the left bank of the stream was a stretch of sand fully $1\frac{1}{2}$ mile in breadth, the whole of which is said to be under water in the months of May, June and July during which season the river is much flooded, both on account of the increase of water from the then rapidly melting snows, as well as from the rain which falls in considerable quantities from April to June. The river is here no longer used for irrigation, as above Shigátzé, but all the smaller streams which issue from the mountains on the north and south are thickly bordered with cultivated land.⁴

Another native explorer, L—, started, in March 1875, from Darjeeling to Shigatse. After crossing Kangra-lama-la or Lachen-la he was taken prisoner and

¹ Reisen in Indien und Hochasien. Bd I, p. 471.

² Proceedings Royal Geographical Society. Vol. XIV, 1869—70, p. 346 et seq.

³ Proceedings Royal Geographical Society, 1879, p. 127.

⁴ Journal Royal Geographical Society. Vol. 47, 1877, p. 116.

sent to Shigatse. His object was to make a route survey along the Tsangpo as far as possible. From Shigatse he was allowed to travel to Yamdok-tso, from where he went northwards, and followed the river to Chetang. Further progress was, however, said to be impossible without a strong body of men, and so he had to return to Darjeeling *via* Gyangtse, Phari and the Chumbi valley, a route which had partly been used by Turner in 1783.¹

In 1877 Lieutenant HARMAN sent a native explorer N—m—g, to Chetang with instructions to explore the course of the Tsangpo as far downwards as possible. He followed it eastwards about 30 miles. After a necessary detour he again struck the river at Gyatsa-jong. About 30 miles below this place he crossed the river to the right bank. The river was found to reach its most northern point near the intersection of the meridian of 94° with the parallel of 30°. Then it turns due S.E., reaching Gya-la Sindong in 15 miles, beyond which place N—m—g was not able to follow it.²

Sir HENRY YULE says in his historical note on The Tsangpo-Brahmaputra problem: Though the identity of this river (Brahmaputra) with the great river of Central Tibet, the Yaru Tsangpu, has never yet been continuously traced as a fact of experience, every new piece of evidence brings us nearer to assurance of the identity, and one might be justified in saying that no reasonable person now doubts it.» Of d'Anville's and Klaproth's views he says: «It seems hardly worth while now to slay this hypothesis, which was moribund before, but must be quite dead since the report of N—m—g's exploration.³

A new proof of the Tsangpo's continuation as the Brahmaputra was given by the journey of J. F. NEEDHAM and MOLESWORTH, in December—January 1885—86, when they followed the Brahmaputra and the Zayul-chu⁴ to Rima. As A—K— on his way from Salwen to Sama did not cross any great river flowing southward, and as the two Englishmen, on the Brahmaputra and its tributary, did not see any river flowing southward, it was obvious and beyond doubt that the Tsangpo could not be identical with the Irrawaddi, and that it could not possibly be anything else

¹ A Memoir on the Indian Surveys 1875—1890; by Charles E. D. Black. London 1891, p. 151. And the Indian Survey Report for 1878—79.

² Proceedings Royal Geographical Society 1879, p. 593. — Black's Memoir, p. 165, contains the description of an explorer, who was a Sikkim Bhutia, called G-m-n, whose exploration took place in 1878. The Chamkar monastery mentioned by the explorer is said to be d'Anville's Tchamca, beyond which the river makes its acute bend, flowing south past Gyala Sindong, the farthest point reached, and the Gimuchen country into a country which the natives said was ruled by the British. Black shows that this journey threw considerable light on the further course of the Tsangpo, and reduced the unknown section of the river to about 100 miles, a distance which was still further diminished by the journey of K—p in 1886—87.

³ Introductory Essay (Dec. 1879) in The River of Golden Sand by Capt. William Gill, London 1880, p. 19 and 24.

⁴ Zayul-chu was the same river as Wilcox's Brahmakund and T. T. Cooper's Brahmaputra. Cooper ascended the river to the village of Prun. A—K— descended it to Sama, about 20 miles from the Assam boundary, and the place where Krick and Boury were murdered in 1854. — Black, p. 155.

than the Brahmaputra. In his first report Needham says: »I marched up alongside of the Brahmaputra the whole way from Sadiya to within sight of Rima, and I can consequently positively assert that no river as large or anything like as large as the Sanpo flows to the southward anywhere on this side of that place.»¹ It is indeed characteristic that only one year before, Mr. ROBERT GORDON, who fought so desperately in favour of the Tsangpo-Irrawaddi, could write: »I find that those who take the opposite view as to the connection of the Irawadi with the Sanpo of Tibet, continue to treat the whole of the evidence unfavorable to them, as though it were non-existent.»² This was the last attempt, except DUTREUIL DE RHINS', to defend d'Anville and Klaproth against the followers of the Capuchins and Rennell. General J. T. WALKER was present at the meeting when Gordon's paper was read, and he defended the right side; he said of the lecturer: »he lays hold of whatever tells in favour of his argument, and ignores whatever is against it.»³

Already before this happened the German geographers had gone over to the right side, as is seen even in the title of a very able article: »Der grosse tibetanische Fluss in seinem Laufe zum Brahmaputra.»⁴ By the way it is said in this article that Nain Sing »travelled through the whole valley of the great Tibetan river from its sources in the Mariamla-mountain to the neighbourhood of Lhasa«, showing that the greatest German authorities had got the impression that the sources were on the Maryum-la.

In the Report of 1886—87 Colonel H. C. B. TANNER has, under the general heading: *Trans-Himalayan Explorations*, an article *On Explorations in Bhutan and on the Lower Sangpo river*, where the narrative of the explorer K—p (KINTHUP) a native of Sikkim, gives a certain amount of information regarding the great river; he reached Onlet one stage from Miri Padam, near the place where the Tsangpo emerges from the Himalayas into Assam, and therefore, as Tanner says: »I conceive that no further doubt should remain even in the minds of the most sceptical as to the identity of the great river of Tibet with the Dihang or Dihong, known lower down as the Brahmaputra.»⁵ K—p travelled in 1884.

Already in July 1880 Captain Harman had sent a Chinese Lama and K—p from Darjeeling to Tibet. K—p had accompanied G—m—n on his journey in 1878 to Gyala Sindong, and now the object was to explore the country below that place, and to trace the river all down to the plains of India, or failing this, to throw marked logs into the river, which should be caught where the river debouches into Assam. The plan could not be carried out as the Lama simply sold K—p as a

¹ Proceedings Royal Geographical Society. Vol. VIII, 1886, p. 265. Needham's diary is published in Supplementary Papers (Royal Geographical Society) Vol. II, 1889, p. 485 et seq. together with a map of his route.

² »The Irawadi River.« Proceedings Royal Geographical Society. Vol. VII, 1885, p. 292 et seq.

³ Compare also General Walker's: »The Hydrography of South-Eastern Tibet», with its interesting maps. Proceedings Royal Geographical Society. Vol. X, 1888, p. 577. et seq.

⁴ Petermann's Mitteilungen, Band 26, 1880, p. 14 et seq.

⁵ General Report on the Observations of the Survey of India Department, 1886—87, p. LXXXVI. Petermann's Mitteilungen 1888. 34 Band, p. 221.

slave in the Pemakoi country and then disappeared. Tanner examined the explorer on his return and believed in his story. K—p, however, reached Onlet and heard that the next stage, Miri Padam, was about 35 miles from the nearest plains of India. »The general direction of the Sangpo for many miles of its course, as estimated by K—p agrees very nearly with that of the Dihang as estimated by Captain Harman. Tanner's *Memorandum* is illustrated by a rather good sketch map on the course of the Tsangpo from K—p's information. The map of the great bend has since then only been altered in details. The falls of the Tsangpo below Pemakoi, not far S.E. of the northernmost point of the bend, are described by K—p as a cascade of some 150 feet in height; there is a basin below the cliff, and in the spray hanging over it the rainbow can be seen; the rock is called Sinje Shejal and there is a shrine. Nearly 30 years later K—p told Captain Bailey that the falls were only 50 feet in height.

G—m—n had not reached the falls. Colonel WADDELL maintains they are known only from hearsay reports, and have been placed about $29^{\circ} 36'$ N. lat. Waddell got an interesting picture of the falls from a Lama artist who was a native of the district. For several miles above the falls the river is known to run in a narrow precipitous defile without a road. Below the falls, in the gorge, there is a rude monastery. The height of the falls is estimated at 70 feet, and they are enveloped by clouds of mist and spray.

Waddell gives us an important etymological evidence of the identity of the Tsangpo and Brahmaputra. The Tibetan word Ts'ang-pu means »the son of Brahma», just as the Sanscrit Brahmaputra. This is, however, a more modern mythological meaning given to the word by the Lamas; for the ordinary name of the river is Tsang-po which means »the pure one, or, in this case, *The River par excellence*. Tsang is the name of the province through which it flows. Yaru-Tsang-po means »The Upper River». Still Waddell thinks the root of the Tibetan name is certainly cognate with that of Brahma.¹

But we must leave this interesting problem of the Tsangpo-Brahmaputra which lies outside the boundaries of my own exploration. I have only touched a few important epochs of the controversy, in which so much hard work, knowledge and pertinacity has been wasted in vain, but which, even for this reason, has helped us to penetrate the dark and mysterious problem.²

¹ The Geographical Journal. Vol. V, 1895. p. 258. — Of the word Tsangpo Sarat Chandra Das says in his dictionary: »gtsāñ-po any river, but usually a large one; esp. the great river of Tibet flowing through the heart of Tibet from west to east and called the Yeru Tsang-po. This river is believed to enter Assam as the Dihong where it presently joins the Brahmaputra just below Sadiya», p. 1,000.

² For the principal literature, see Richthofen, China III, p. 380 et seq. In 1913 Captain F. M. BAILEY and Captain MORSHEAD made a most important journey in this little known or quite unknown part of the famous river. Amongst their results was »the mapping of some 380 miles of the Tsangpo, which had previously only been done by untrained or unreliable explorers. — Exploration on the Tsangpo or upper Brahmaputra. By Captain F. M. Bailey. Geographical Journal Vol. XLIV, 1914, p. 341. et seq.

CHAPTER XLII.

EUROPEAN SPECULATION BEFORE RYDER'S SURVEY.

In this chapter I will only give a few examples of different European geographers' opinions regarding the northern tributaries and the northern watershed of the Tsangpo. On BRIAN H. HODGSON's map the watershed is formed by an enormous range, which we shall consider later on. From its southern side the tributaries of the Tsangpo come down. They grow slowly larger towards the east. They are very like each other and one sees that everyone of them is home-made. There is not a line on this map that has a remote resemblance with really existing facts. The single tributary which can be identified is the Ki-chu, and that only by help of »Hlassa», situated on its bank. As compared with this map d'ANVILLE's and the Ta-ch'ing maps are ideals of exactness and correctness.

On SAUNDERS' map, which was also published in Markham's book on Bogle and Manning, the same gigantic range is generally the northern watershed, but the tributaries are drawn as found by Nain Sing. Only the Charta Sanpo breaks through the watershed range. Some of the plateau lakes and rivers are taken from the Ta-ch'ing map or d'Anville's, and Nain Sing's new lakes, Dangra-yum-tso and the rest, are also there.

On GRAHAM SANDBERG's very rough sketch map¹ there is, just south of Nain Sing's lakes, a long range, Torgot Gangri, stretching west to east. The "Chhorta Chhu" or Chaktak-tsangpo begins even a short distance north of that range, at the same latitude as the southern shore of Dangra-yum-tso. But Tsa Chhu and Naku Chhu begin at the southern slopes of the western continuation of that same range.

Sir THOMAS HOLDICH's opinion is expressed in the following words:² »Somewhere on the southern edge of the Chang is the water divide of India. No one has defined its exact geographical position. Some of the gigantic lakes of Central Tibet may possibly be within the Indian basin, but of many of them it is known that they have no outlet.» He even speaks of »the valley of the upper Brahmaputra,

¹ In »The Exploration of Tibet». Calcutta, London 1904.

² Tibet, The Mysterious. London 1905, p. 36.

where the yellow glacial streams pour down from the outer Himalayan wall, or the clear flow of currents from the central lakes join the main stream . . .¹ Further on Sir Thomas expresses the same view in the following words: 'Judging from the great size of these northern tributaries, and the number of them, there certainly seems good reason for supposing that part of the central lake district lies within the Brahmaputra basin. There is no other way of accounting for their volume. The southern tributaries from the Himalayan glaciers are comparatively insignificant.'² And again: 'From some of the innumerable lakes (the desiccating remains of ancient snow-fields which border it³ on the south) it is probable that those big affluents of the Brahmaputra noted by Nain Sing must take their rise . . .'⁴

Such an opinion as this is by no means surprising and does not even seem too audacious. On the contrary. At the time, 1905, when Sir Thomas Holdich published his book, the opinion he expresses was the most likely to be correct. From the material then existing everybody would have been induced to «capture» some of the central lakes within the drainage area of the northern tributaries of the Tsangpo. And nothing else existed, except d'Anville and the Ta-ch'ing map. On both of them two or three of the northern tributaries are actually drawn as coming from lakes. Sir Thomas, however, does not derive his conclusion from the Chinese maps, but from the size of the tributaries and the clearness of their water, as reported by Nain Sing. We have already seen that Montgomerie concluded from the clearness of the water, that these rivers could not be fed by glaciers. Thus, indeed, it would seem likely, that they had passed through lakes.

On F. GRENDAR's map⁵ Tchou Nag and Tcharta Tchou come from lakes, which, however, are situated south of the main watershed. This is indeed the case with Chaktak-tsangpo (Tcharta Tchou), although its course, as taken from the Chinese map, is rather fantastic.

In 1905 Graham Sandberg expresses his views as follows:⁶ »The rivers which debouch into the Támchhok from the north are all of such considerable volume that they must have had a lengthy run before reaching the point of junction. Accordingly we ought to set back the northern watershed of the Támchhok many miles further north than the actual valley line wherein the channel runs. The incoming northern rivers cut through the low lines of hills bounding this valley on the northern banks: whence, then, do they hail? One would imagine that, in all probability, the massive mountain range, practically a continuation of Mount Kailas, known to geographers as the Gang-dis-ri range (really Gang Tise Ri) stretching east across Tibet, gave

¹ Ibidem, p. 38.

² Ibidem, p. 234.

³ Littledale's route westwards.

⁴ Ibidem, p. 285.

⁵ Carte de l'Asie Centrale dressée d'après les travaux des explorateurs modernes, les cartes chinoises et les renseignements d'indigènes par F. Grenard, dessinée par J. Hansen. 1899.

⁶ Tibet and the Tibetans, London 1906, p. 79.

birth to these feeders. This range passes eastward from forty to seventy miles north of the general line of our river, and in the main forms the southern watershed of the great lake plateau. However, recent exploration shows that, in the case of several of the great northern feeders of the Támchhok, in the first and second sections, they rise further north still than the Gang-dis-ri range, and even on the lake-plateau itself. They pass through gorges between lofty peaks in this range, much as do the Indian rivers in their course through the Southern Himalayas. We interpolate these remarks here, because the Chhorta Tsangpo, which bounds our Second section (from Chhorta to Shigatse) is one of the great feeders, whose early course has been traced back north beyond the Gang-dis-ri range; its primary sources being found in certain lakes to the S.W. and S. of Dangra Yum T'so.»

I should have inserted this passage after Ryder, but as Sandberg has not at all used Ryder's authority, it rather belongs to mere speculation. He concludes that the considerable volume of the northern tributaries prove a long course. Therefore he removes the northern watershed to the north. Thus »the massive mountain-range situated here, should most likely be regarded as the watershed. But that has been found not to be the case. It would be interesting to know which »recent exploration» has followed the northern tributaries up on the lake-plateau itself! I had not yet begun my journey when Sandberg wrote, and Ryder had arrived at the opposite conclusion to Sandberg's »recent exploration». In reality not one of the northern tributaries comes from the lake-plateau. And who had, in 1905, traced the early course of the Chaktak-tsangpo back north beyond the Gang-dis-ri? Sandberg's description of this part of Tibet is mere fiction. If he had said old instead of recent exploration, one would have thought of the Lamas and of the Ta-ch'ing map. Probably he has got his impressions from Saunders' map, which, for this part of Tibet, is also mere fiction.

CHAPTER XLIII.

RYDER, RAWLING, AND BURRARD.

The principal geographical result of YOUNGHUSBAND's famous mission to Lhasa was the excellent map drawn of the Tsangpo valley. Of the tributaries only the Nyang-chu and Maryum-chu were completely surveyed as well as the lower part of the combined Ki-chu. Of the other tributaries not much more could be touched than had been seen by Nain Sing. But from their triangulation stations RYDER and his comrades had a much wider view than Nain Sing could get from the road. Thus, for instance, Raga-tsangpo has got a great number of northern tributaries and Amchok-tso is an important addition. The Chaktak-tsangpo and Tsa-chu-tsangpo have been enormously improved. Ryder's map of the Tsangpo and of the courses of its tributaries so far as they could be seen, will for ever remain a foundation for future exploration in these parts of Tibet. Thus his map has a greater fundamental and historical importance than any other in existence, only except the Chinese maps, which must be considered for a much greater area. As RAWLING's and Ryder's expedition was for a great part of the journey separated into two parties, it often carried out so much work as two ordinary expeditions would have done.

Ryder crossed three southern tributaries, two of them called Shap Chu and Sakyatrom Chu, and then followed the lowest part of the Chi Chu. South of Kura La (17,900 feet) he touched the headwaters of Chi Chu. From Sheru La (17,600 feet) a very small tributary goes down to the Tsangpo. Between Chi Chu and the brook of Sheru the Tsangpo was found to run between rocky hills with snow-peaks on either side.

A short distance above Lhatse Captain WOOD found, on October 26th, a ford, by which the ponies were able to cross the Tsangpo. Wood says of the valley of the Raga-tsangpo:¹ that it is narrow, running almost due east and west, parallel to and about 30 miles to the north of the main river . . . On November 5 we crossed the Ku La (16,700 feet),² situated at the headwaters of the Raga Tsangpo, and by a steep descent dropped into the valley of a small stream draining into the Tsangpo. Near Saka-dsong Wood ascended a peak to the north (19,300 feet), from which he had a fine view north up the valley of the Charta Tsangpo.[»]

¹ Exploration and survey with the Tibet frontier Commission, and from Gyantse to Simla via Gartok. By Major C. H. D. Ryder. Geographical Journal, Vol. XXVI. October 1905, p. 385.

² Identical with Nain Sing's Gurla Pass.

Where Ryder crossed this river, lower down, he found it to be »a fair-sized affluent.» Wood, who crossed it higher up, says: »On leaving Saka Dzong, our party kept down the valley till we reached the Chata Tsangpo, which we found no difficulty in crossing. The stream was at that time some 100 feet in width, with a depth of 2 feet, flowing in one channel, having just left a very deep narrow valley to emerge into a plain of about 3 miles in width.»

On the 16th of November Ryder found the Tsangpo so completely frozen over, that the caravan could pass on the ice. Of the plain W.N.W. of Tradum he says: »This plain is full of small ponds lying among sand-dunes, and there was an unpleasant tributary or two to cross, the water frozen at the edges for 4 or 5 yards. Then follows his description of the way up to Maryum-la which we know.

Ryder gives the very highest credit to the native explorers, notably Nain Sing and A— K—.¹ And he adds: »In place of these rough maps, we have now an accurate survey of the country traversed by the expedition.» In Rawling's opinion the report compiled by Montgomerie is »somewhat meagre», though both Nain Sing's and Montgomerie's merits were extremely great for their time.²

Rawling regards the Chi Chu as »a stream of considerable size rising in the southern hills». There are hot springs in the valley. Raga-tsangpo and Chaktak-tsangpo are not mentioned. Of Tsa-chu there are no particulars in the reports. But Rawling tells us that the river near Tuksun »is a stream of considerable size, having a width of 150 feet. Probably during the rainy season it overflows its banks, but even in this state would be fordable in places. Now it formed a solid sheet of ice . . .».

The British missions to Lhasa and Shigatse have of course come into more intimate contact with the Nyang-chu and Ki-chu than with any other part of the Tsangpo system. At the time when Tashi Lama returned from India DAVID FRASER visited Shigatse together with Captain FITZGERALD. On the outward journey they took the ordinary road, but for the return a more westerly road over unknown ground was chosen. Fraser gives some short descriptions of the Nyang-chu and concerning its origin he says: »Out of the Kala Tso flows the Nyang Chu, the stream which waters the Gyantse Valley and enters the Tsangpo . . .³ Thus it is also represented on the map in EDMUND CANDLER's book.⁴ Colonel WADDELL, however says of Kala-tso: »This lake, which is said to have no outlet, is subject to some change of level, rising in the rainy season for a quarter of a mile or so . . . The water, although clear, was slightly brackish, and the shore covered by a white saline crust, which supported the local report that the lake has no outlet — although in the maps of our native surveyors, and in Bogle's account, it is made to flow into the Gyantsé river on its east.⁵ And again PERCEVAL LANDON says of the Nyang-chu: »This stream does not

¹ Loc. cit., p. 369.

² The Great Plateau, London 1905, p. 163.

³ The Marches of Hindustan etc. London 1907, p. 23.

⁴ The Unveiling of Lhasa, London 1905.

⁵ Lhasa and its Mysteries, London 1905, p. 181.

run from the Kala-tso, as is represented by many maps. It rises in a full head of water that breaks from under an old glacier bed which fronts the eastern end of the Kala plain, and flows with an even and increasing current in a northerly direction.»¹

On Ryder's map the main branch of Nyang-chu comes from the mountains west of Yamdok-tso, whereas the Kiang Lope Chu, which originates from the neighbourhood of Kala-tso, is a tributary. Ryder says in his text: There is no outlet to the Kala Tso, but there are obvious signs that in ancient times the water flowed out of the lake into the narrow gorge, and so to Gyantse and the Tsangpo. About 8 miles from the lake in this direction a small stream rises from what is probably an underground flow from the lake, and flows in a broad and deep bed down the gorge.»²

At the present time Yamdok-tso seems not to possess an outlet, but of Rung-chu, which flows into the Tsangpo, Ryder says: »I have no doubt whatever that this is the old outlet of the Yamdrok Tso, which now is land-locked.» As the lake is fresh it may be an analogy to Rakas-tal and the Satlej.

As in the case of the source of Nyang-chu the opinions are so different with Europeans who have visited the place almost simultaneously, one should not expect too much from other tributaries to the Tsangpo. It should be remembered, however, that Turner on his map makes the river rise not from, but east of the Kala-tso and that he even writes on his map: »Sources of the River Painom-tchieu.» This view is obviously quite correct and there is no probability for a periodicity of the same kind as the Rakas-tal and Satlej. Of Bogle's visit to the lakes Markham says: »Four days after leaving Pari, Mr. Bogle discovered two large Alpine lakes, called Shamtzo and Calutzo, connected with each other by a stream. He also traced the river flowing out of the Calutzo Lake, and found that to be a tributary of the Brahmaputra, and identical with the Penanang-chu. The name of the second lake and the direction of the outlet are entirely new geographical facts.»³

Colonel S. G. BURRARD places the Nyang-chu very clearly in the following words: »The Nyang tributary rises near two lakes north of Chumalhari, forces its way through the Ladak range, and falls into the Brahmaputra near Shigatze. It is the only Tibetan tributary of the Brahmaputra that drains the great Himalayan range and the only river east of Manasarowar that pierces the Ladak range . . . The Arun, the Kali Gandak, the Birehi and others rise in the Ladak range and pierce the great Himalaya, the Nyang rises in the great Himalaya and pierces the Ladak.»⁴ He regards the Ki-chu as rising from the Nien-chen-tang-la range and forcing its passage through the Kailas range. He regards the bifurcation of the Kailas range

¹ Lhasa, London 1905. Vol. I, p. 163.

² Geographical Journal. Oct. 1905. p. 372.

³ »Travels in Great Tibet . . . etc. Journal Royal Geogr. Society, Vol. 45. 1875, p. 303. Possibly the Chon-tala on d'Anville's map is identical with this place. If that be the case d'Anville has the river as starting from the lakes.

⁴ A sketch of the Geography and Geology of the Himalaya Mountains and Tibet. Part III, Calcutta, 1907, p. 156.

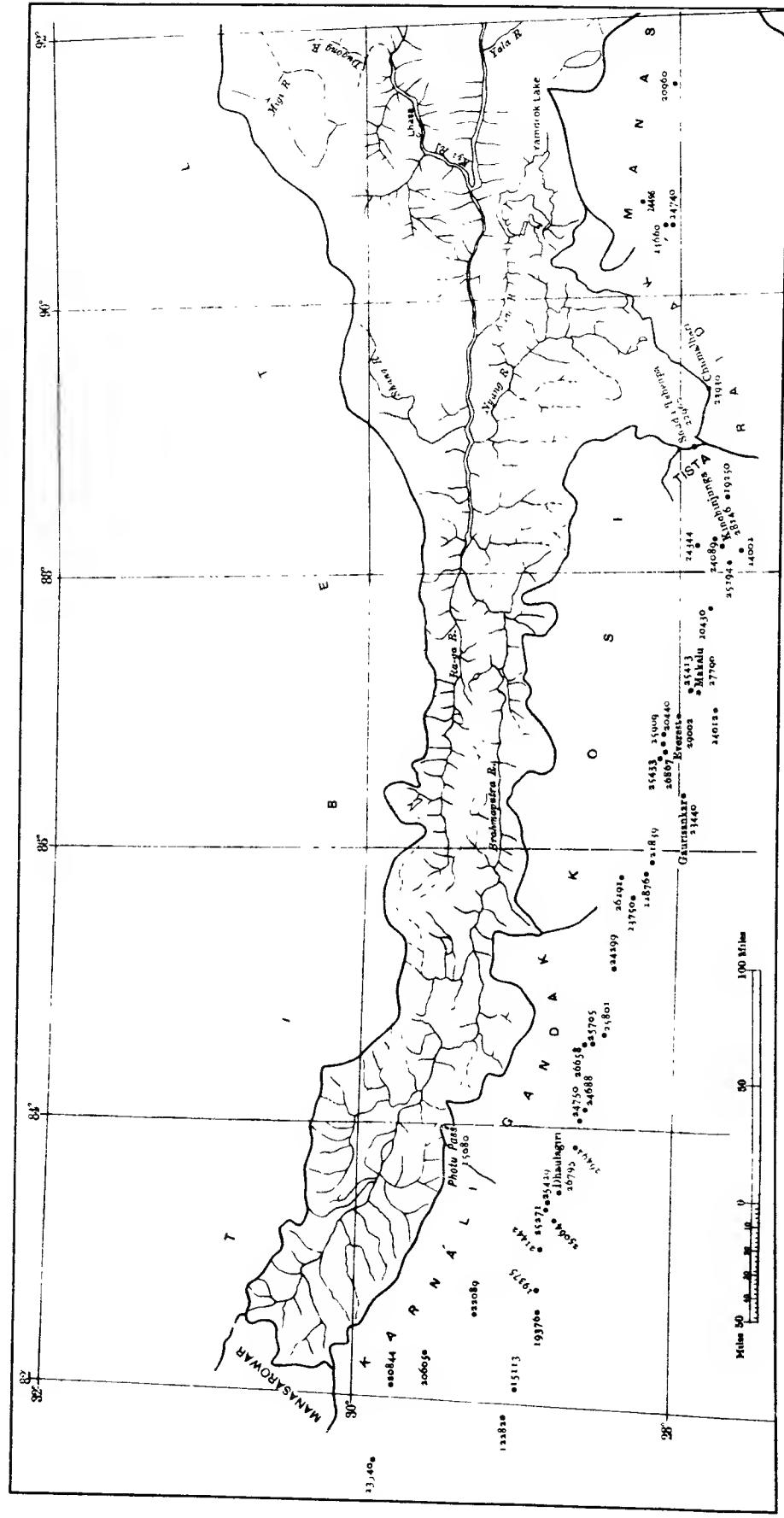
as the cause which gives rise to the Raga-tsangpo. He observes that the Ki-chu, Nyang-chu, Rong-chu and Shang flow against the Tsangpo itself.

Of the watershed Burrard says:¹ 'The water-parting between the Indian and Tibet basins cannot be drawn with certainty: in places it is without doubt the Kailas range, but the latter has been cut through from the north by feeders of the Brahmaputra whose basins have not been determined. The Lhasa river, the Charta and others drain through the north of the Kailas range, and pierce the Kailas range in the same way as the Himalayan rivers pierce the Himalayan ranges.' The Chaktak-tsangpo, however, pierces two ranges and rises on a third, which in this part is the watershed between India and the plateau-land. The whole orographical arrangement can hardly be compared with the Himalaya, as in the case of Chaktak-tsangpo the water-parting is also on one of the most considerable ranges in the country north of the Tsangpo.

On his Chart XXX (Pl. XXIII) Burrard gives a good idea of the Himalayan area drained by the Brahmaputra. Only between $84\frac{1}{2}^{\circ}$ and 89° East long., is the northern watershed incorrect. It is given from the materials brought home by Ryder. But even from high stations it would be quite impossible to judge from how far the northern tributaries come, as is clearly seen on the map. Chaktak-tsangpo, for instance, is represented as rising too far south. The drainage area of Amchok-tso is represented as making an apophysis to the north and as if the ultimate feeders of the lake should reach further north than its neighbours. But in reality the area of Amchok-tso, marked by Angden-la, is the southernmost point on the whole watershed between $84\frac{1}{2}^{\circ}$ and 89° . In some cases the watershed has been drawn $\frac{2}{3}^{\circ}$ too far south. On the whole section it is represented as situated south of the 30° lat., whereas it in reality crosses this parallel only at one place, Angden-la.

In the course of time this watershed has wandered up and down like a pendulum. As nothing was known every explorer or geographer could accept, *ad libitum*, whatever limit he personally thought to be the most likely one. In the preceding chapters it has thus been seen how the watershed has sometimes been too far north, sometimes too far south. It was my good luck to settle this feature, one of the most important in Asia, although, from reasons easy to understand, my survey could only be a reconnoitring, and the mathematically precise survey was to be left to the future. To take only one example we find the northernmost feeder of the Chaktak-tsangpo on the Ta-ch'ing map at $31\frac{1}{2}^{\circ}$ North lat., on DUTREUIL DE RHINS' *Première transformation de la Carte Chinoise* at $30^{\circ} 55'$, on d'Anville's *transformation* at $32^{\circ} 5'$, on Saunders' map at $30^{\circ} 27'$, on Ryder's map at $29^{\circ} 42'$; in reality it is situated on Sangmo-bertik-la, at $30^{\circ} 15'$. As I crossed the watershed between $84\frac{1}{2}^{\circ}$ and 89° only at five points, I could only sketch it roughly, and between these five points there is, of course a great deal of work left to be done.

¹ Ibidem, p. 125.



The Himalayan area drained by the Brahmaputra, according to Burrard, 1907.

MY JOURNEY ALONG THE TSANGPO

ON THE ROAD TO SHIGATSE IN THE VALLEY OF THE TSANGPO.



CHAPTER XLIV.

THE TSANGPO FROM KARU TO SHIGATSE.

In the next volume of this work, when dealing with my eight crossings over the Transhimalayan system, I shall have an opportunity to describe those of the northern tributaries, with which I have made acquaintance. In this connection I will only describe those parts of my own route which touch the great Tsangpo, and a few of the small tributaries to its upper course. The general map of my journey will show that I have avoided as much as possible travelling in the valley of the Tsangpo. This route had been done by Nain Sing, and then by Rawling and Ryder, whose excellent map could not be improved by me, when I travelled without permission and alone with Asiatics. But keeping north of the river, and in two cases, south of its course, I could add new survey to Ryder's map. Only for $2\frac{1}{2}$ marches I could not avoid following the same road as Ryder. From the confluence of the Raga-tsangpo and Tsangpo, and down to Shigatse I travelled along the northern bank of the river, a part of the course which had not been surveyed by Nain Sing and Ryder. Below the confluence with the Chaktak-tsangpo I followed the great river for only half a march, and for one day's march I again followed it from Chärok to Shamsang. Otherwise I only crossed the Tsangpo at seven different places, and thus got a better idea of its hydrographic capacity and characteristics than anyone of my predecessors.

Karu is a little village where, on my road down from the first crossing of the Transhimalaya, I first reached the Tsangpo. From here I travelled, on February 7th and 8th, 1907, along the northern bank, and on February 9th with a hide-boat on the river to the ferry place which is nearest to Shigatse, on March 27th 28th, 29th and 30th, 1907 I returned from Shigatse to Karu. My wish to follow the southern bank for the return journey was not granted by the Chinese authorities, so I had to take the same road twice. I had at least the satisfaction to get exactly the same names from different guides for villages and valleys passed, and had a good opportunity to control how far the Tibetans were reliable in their information.

At the southern side of the valley are high, imposing mountains, and at their foot the village Rokdso with a ferry. Above Karu is the little valley of Karu-pu with a small brook in a broad gravelly bed. A short distance beyond Karu the road touches the first promontory of living rock on the river, Nanka-song, decorated with an idol, and consisting of gray granite, which continues eastwards, sometimes interrupted by turmaline quartzite. The ground has been arid for a bit, but now again some grass and steppe plants appear. From the southern mountains enters a rather large tributary, Soo, with a two days' road to Selung; beyond a pass further south are said to be the villages of Laku-lungu, Sa, and Valung, and further on the road continues to Nepal.

East of Karu the road has been cut down by traffic through the *loess*-beds to 4 m. depth; this curious passage is at many places crossed by ravines, and through the openings to the south one sees, as through a gallery, the mountains on the right side of the river; at some places rain and wind have formed out pyramids and pillars in the soft deposits. Finally the corridor gets shallow and disappears altogether. Here the road really gives the impression of a considerable traffic, though now only peasants with horses, yaks and donkeys were met, and pilgrims seen on their way to the new year's festivals in Tashi-lunpo.

A little further on the road passes an open alluvial plain, now dry, but inundated during the high-water season. The sand brought down and deposited here by the high-water gets dry when the river subsides, and then 2 m. high dunes are formed. The next high-water sweeps them away, and a new set of dunes is formed the next autumn, winter and spring. In the summer the entire bottom of the valley is filled with water, and the road has to run along the mountain side, where Yakpo-chedung is a solitary hut with a ruin on a rock above it.

The river here flows in one single channel, the water was nearly clear, blue-green, and there was hardly any ice at all along the banks, only some floating pieces. The current is slow; there are no rapids at all the whole way down to Shigatse, and only seldom does one hear the murmur of the running water. Hide-boats loaded with hay and corn are occasionally seen drifting down to Shigatse. Along the right side of the valley two erosion terraces have been carved out in the mountain-foot; at the left side the terraces of gravel and shingle are more interrupted. Some of the gorges at the southern side were filled with ice, but there was no sign of snow anywhere in the valley, and seldom on the mountains at its sides, of which, however, only the nearest shoulders and ridges and ramifications are visible from the bottom of the deep and comparatively narrow valley. The view to the south, and especially north is therefore very limited; to the east one has a charming and magnificent perspective of the valley passage with the mountain culisses sloping down from both sides, and appearing in lighter colours as the distance increases. The river, like the valley, is fairly straight; the bends which exist are slow and moderate.

The river, here called Sangche or Tsangpo-chimbo, »The Great River», generally keeps to the southern side of the valley, where the mountains are higher, more massive and bulky, darker, steeper, and more rocky than along the northern side. At a place at the southern side, where the river sweeps directly along the foot of steep rocks, a dangerous road crosses the cliffs. Sometimes cairns with a pole and a flag near the bank serve as signs to the drifting hide-boats.

The ground is either hard yellow alluvial clay, gravel or sand. At the lee-side of every bush or tuft of grass, there is a small accumulation of sand, always on the east side, showing that west winds prevail. There are also well-formed wandering dunes without binding vegetation, and always with the steep lee-side to the east.

The next tributary from the south is Mi, not very great, and with a village of the same name. Cho-lamchang is a village of a few huts and corn-fields on the road; on a hill above it are the white houses of a nunnery simply called Chöding, and below it is another part of the village of Cho; the monastery is also called Cho-chöding. The road is here at some distance from the river.

Then follows a great tributary from the south. Its name is Shablung or Shabnang; Ryder who crossed it higher up calls it Shap-chu; Shab-lung is the valley, Shab-chu its river. In its mouth, west of the river-course, rises an isolated little rock with a monastery, Chöni-kera, or, as others would have it, Chuki-kera. Three days up the Shab valley, at a place called Tsalung, wild onion is common and collected for the use of Rungma's inhabitants. Other places or tributaries to the Shab are Pese, Geding, Chamo, Sandugang and Taga. The Shab road to Phari was said to take 15 days by horse and 30 by yak, the road to Sekya-gompa 10 days on foot. These distances seem to be much exaggerated. The Shab is impossible to ford in summer; at the time of my visit there was not much water in its bed. From the Shab valley are also roads to Tashi-lunpo and Ladse-dsong.

At the granite promontory of Shärtang almost the entire bottom of the valley seems to get inundated at high-water time. Now the river was divided in two or several branches; a pool of back-water still remained in a dry bed. A comparatively great tributary from the north is called Donka with a village of the same name, and a nunnery, simply known as Chöde, with only one nun.

In Rungma I got the height of 3,940 m. (12,923 feet). The village has some 25 huts and two fairly good houses; wheat, corn, peas and radishes are cultivated. Rungma is built on a gravel and shingle terrace, between the foot of which and the river there is some level ground for cultivation; there are in the village a few gardens with poplar-trees.

From Rungma the valley turns to the N.E., and the river is out of sight. For a considerable distance the road follows along fields, arranged amphitheatrically as in Ladak, to make the irrigation water run from the higher to the lower fields. Immediately below this belt of cultivation stretches the now dry summer-bed of the

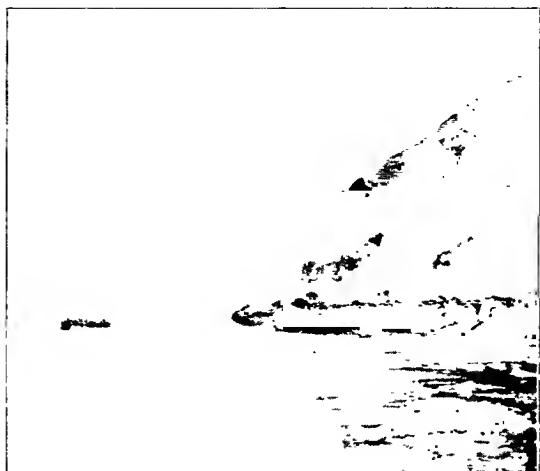
river, and immediately above it the mountains rise; a part of these mountains was called Sabget-la. The road consists of several paths more or less parallel with each other, and fairly deep cut by traffic. From the south enters the valley Tsoo. Yung or Shung is surrounded by great cultivated fields, in uninterrupted connection with those of Rungmia. To the south is a peak called Garpo-basang.

The cultivated ground now comes to an end, the ground is gravel and sand with some steppe-vegetation; the limit between the gravel and sand slope and the summer-bed of the river is very sharply drawn. The Tsangpo again is within sight, divided into two branches. To the left are the villages of Tsookung and Urgendsong, with small valleys from the north; Dsong-chöte is a monastery; Goyang is a village in a valley from the south or right, Pooshan and Lungpa-shär valleys from the north, Deva-lungcha a village, Siglung a valley at the same side. *Mani-rigmos* and *chortens* are often built along the road. The living rock is mica-quartzite.

The valley of the Tsangpo now becomes narrower. The river sweeps immediately along the foot of the mountains at the northern side of the valley. During the summer one has to take a rather uncomfortable zigzagging road over the rocks; now a laid road of blocks along the foot of the rocks could be used, and only a little spur of the cliffs had to be crossed. This road was only 1.3 m. above the surface of the Tsangpo, and from water-marks one could see that the water-level used to be about $1\frac{1}{2}$ m. higher in summer than now. This passage is called Lamo-tang. From the height of the little spur the view is splendid; one has the great river below one's feet, very broad and with half of its surface covered with drifting ice, though the view is much hidden by the westerly gale and sand-drift; the valley is framed by compact mountains. Going down from the spur we see the summer-road joining our path, and provided with a rough stone balustrade. Where the road again reaches the bottom of the valley the river makes a bend to the south and disappears for a while.

From the north or left side enters the valley Logong near the village of Chinde; on the southern side are the villages of Chebling and Ma. Chinre-metong then enters from the north. The promontory Pama-tseble consists of mica-quartzite. The level plain beyond it is called Tseble-tang. The ground is sandy. The Nap-chu tributary enters from the south.

Finally follows the largest of all the northern tributaries we pass between Karu and Shigatse, namely, Ta-nakpo with its brook divided in several branches over a gravelly fan, Ta-nakpo-chu, containing some 8 cub.m. a second, and coming, as the natives said, from Chang-la-Pod-la, which means the water-parting between Pod or Pö, Tibet Proper, and Chang or the northern plateau-land without effluence to the ocean. The name of the valley and of the comparatively well populated district below its mouths is generally pronounced as Dana or Tana, i. e. Ta-nak; one also hears the name Ta-nak-pu or »the upper valley of the black horse«. Chügü is said to be a tributary in its upper reaches. Not far from our road, but still in the Ta-



THE RIGHT BANK OF THE TSANGPO, NEAR SHIGAISE.



THE TSANGPO AS SEEN FROM THE TERRACE
OF TA-NAK.

LOOKING WEST FROM LAMO-LANG.



THE TSANGPO, LOOKING WEST FROM
LAMO-LANG.



THE SAME, LOOKING EAST.



HIDE-BOATS ON THE TSANGPO, STREETS AND "CHORTENS" IN TASHI-LUNPO,
A GARDEN IN SHIGATSE.

nakpo valley, are the village of Rangjon, and two monasteries, Tragun and Tashi-ding. Yangyu, Dröma-buk, Rigu, Nasa, and Hlagü, are villages of Ta-nakpo. All these villages are irrigated from the Ta-nakpo-chu, and for a good while the road passes between villages and lonely houses and huts. The houses are white and look clean, and are all provided with religious flags on the flat roof. The limit between the gravel fan of the tributary and the cultivated ground is extremely sharp. In the background of the valley high and partly snow-covered mountains are to be seen, though the view does not reach far; the form of the bed proves that very great volumes of water flow down the valley during the rainy season.

The chief village of Ta-nak, Lindug-ling, is situated on a dominating terrace of gravel and shingle, from the top of which one has a beautiful view of the river which just below the terrace crosses its valley diagonally to the left or northern side. To the south is the dark mountain Seduru, behind which Tashi-lunpo is situated. To the north is a mountain called Shär-ri, to the N.W. another called Nub-ri, the eastern and western mountain. N. 12° E. near the river, is a dominating peak, Meshung, called Chang-ri or the northern mountain by other informants. To the N.E. are the Sasang mountains, and a valley in their neighbourhood is Yangyu. Tangbe is a village in the same neighbourhood. S. 70° E. is the Gyangtse-pu valley, S.E. Mount Chakuk; S.S.W. is a valley called Nyepshur.

Ta-nak is a kind of embarkation place to Shigatse and Tashi-lunpo. Here hide-boats are to be hired for the journey down the river, paying one or two *tenga* a person. The boats are then carried back, each by one man, on the road along the southern bank of the Tsangpo. The river was here called Tsangchen or Sang-chen, »The great Tsang», or Damchok-tsangpo.

Leaving Ta-nak with a hide-boat one soon passes the fine white houses of the picturesque village of Sigu on the left bank. At the foot of the terrace the current is slow, but soon rises to 1,25 m. a second; approaching Shigatse the velocity is only about 0.75 m. a second. The river-bed is constantly changing, sometimes it is deep, sometimes broad and shallow, and the gravel on the bottom visible through the fairly clear water; the season and the slowness of the current explain the relative transparency of the water. The valley becomes somewhat broader, and the river is more bending from one side of the valley to the other.

Yangyu is a valley from the north, Pani a village at the mouth of its neighbour. Almost everywhere the banks are alluvial and temporary, and rarely is a steep grass-covered bank seen, which is not inundated in summer. To the right is the Danjin-pu valley with the village of Danjin, and further on another, Sigu. Tsume-gompa is situated in a valley to the left. In the afternoon the drifting ice had considerably diminished, but later on again increased. Sometimes the river is divided into several arms, sometimes it flows in only one bed with great velocity. A considerable distance the river goes directly along the foot of the southern rocks where there is only room enough for a well built road with some traffic, transport

from the country to the town, fire-wood on donkeys, boat-carriers returning to Ta-nak, etc. Here the last projecting rock is Chösum-chang, and the valley opening behind it is Nakpo-moo. At the northern side is Chomo-tsong; further east is a rock Tasa, a village named Kapde, and a monastery called Ganda-chulung-gompa.

Then follow, on the left bank, the village of Siting and higher up Tsagulung, the valley and village of Dongka and above it Chülong-gompa. To the right is the Ngoreyung valley. Here the river is broad and slow. Low sand-dunes are seldom seen on the banks, but very often the ground is covered with sand. Again the river approaches the southern side, where the villages of Chang-tang, Tashi-gang and Chang-gang are situated on level ground at the foot of the mountains, and surrounded by some gardens. At a last promontory of gneiss and granite is the place where the boats generally land, and which is therefore called Chuchum; from here it is only 5 km. or 3 miles to Shigatse.

On my way westwards from Shigatse I travelled by land to Ta-nak, on March 27th and 28th, and will give a short description of this road.

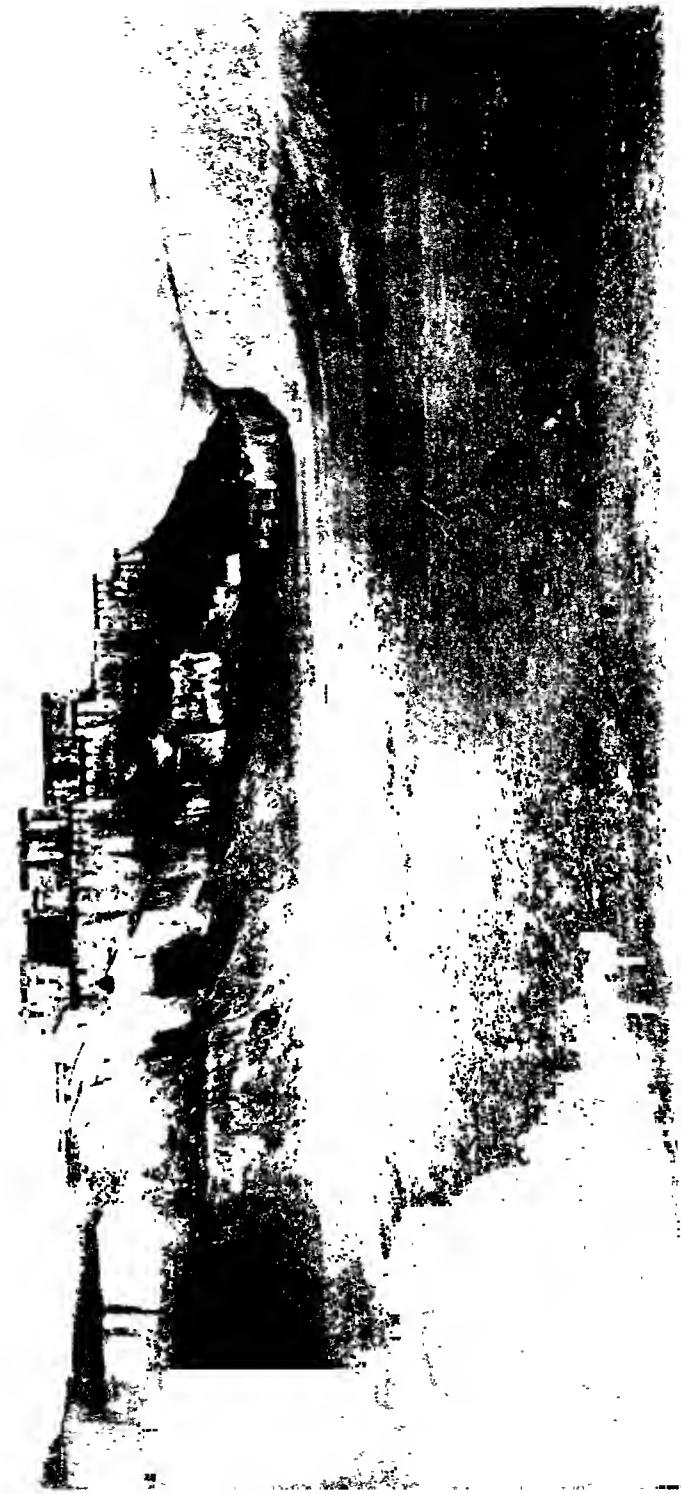
The famous monastery, Tashi-lunpo, Shigatse *dsong*, and a great *chorten* are left behind and the gardens and belt of vegetation along the course of Nyang-chu disappear as we enter a ravine or passage in yellow *loess*-clay. At Chuchum we again pass the promontory between the Nyang-chu and the great Tsangpo and pass along Chang-gang and Chang-tang after which our direction becomes N.N.E. over the now dry summer-bed, which is full of gravel rounded by the river. In stormy weather, and with nothing of the surrounding country visible for dust, we cross the river, which is streaming in one strong arm, and seemed to have about the same volume as 50 days before. Then again follows a very broad, now dry part of the gravelly bed, here and there with sand-banks and deeper furrows. We camped in Sadung near the foot of the northern mountain side, where I got a height of 3,869 m. (12,690 feet). The mountains above Sadung are called Pashi-lung, and near them is a small peak, Hla-tsemo. The breadth of the valley is here a little more than 5 km., and the breadth of the high-water river about 2 km.

At Sadung the above mentioned valley of Dongka-pu comes down; a road goes up this valley to the pasture grounds and valleys of Nyangra, Mudik and Charo, inhabited by nomads; after two days it reaches Dongka-la beyond which is a pasture-ground Ta-nakpo, perhaps simply the upper part of the great Ta-nakpo valley. From Sadung downwards my informants only knew the following villages on the northern bank: Erung, Gänje, Kadok, Tagelung, Choga, Shamba, Shang, Ema-kang, Tsedung, Ker, Tsar and Topka, the last probably not very far below the entrance of the Shang valley. The natives of Sadung knew the road up the Shang valley and had heard of several side roads from it, amongst others one to Shansa-dsong. Three days down the river is a village Shära, opposite Dsong-rimbo, from where it is said to be another four days to Chaksam ferry. Except Shang and Ki-chu no

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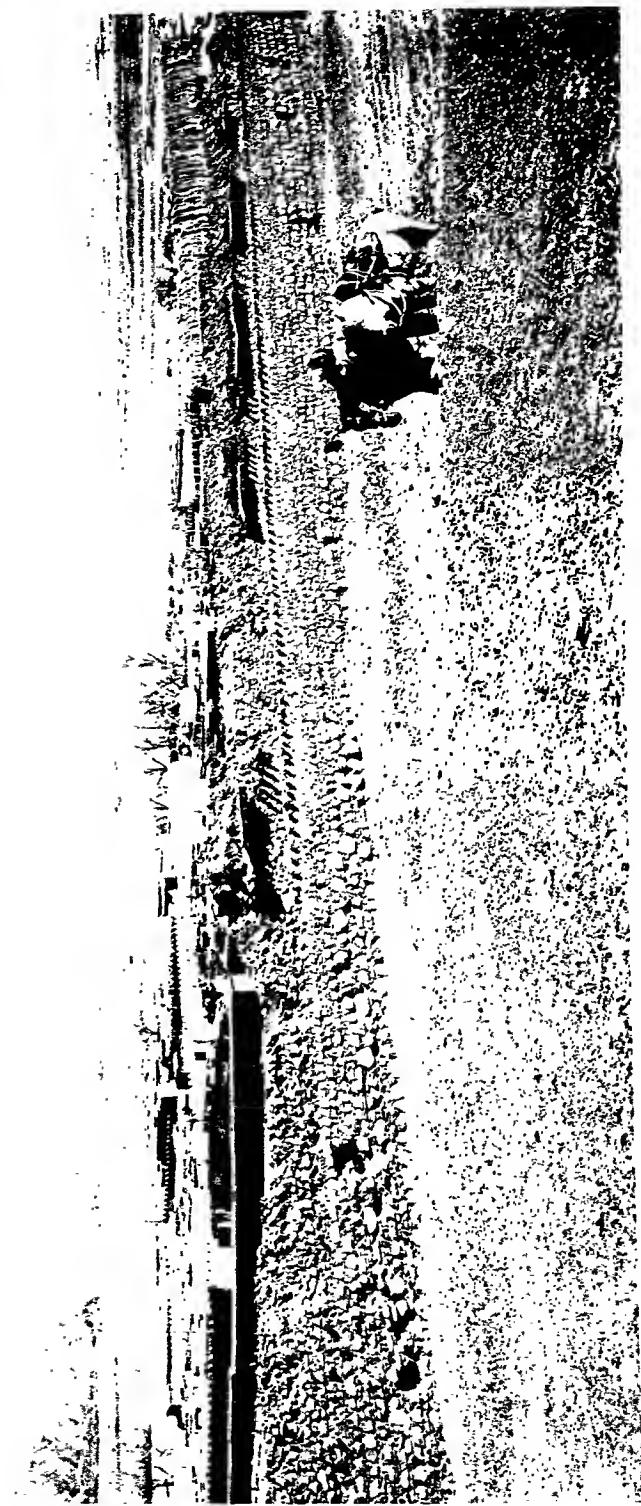
SHIGATE-SONG



SINGAPORE-DSONG.



PART OF SHIGATSE-DSONG FROM THE SOUTH-EAST



SUGARATE, LOOKING SOUTH-EAST.

Von, H.



FIG. V. A. 1. V. OF SINGATSP. TRUNK NO. SOUTH.

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SHIGATSÉ, LOOKING EAST.

great valleys are said to come down from the north. At Sadung the river is called Damchok-kamba.

In the morning and comparatively clear weather the perspective to the east was very picturesque. The ramifications, of brown and grey-brown colour, were seen from afar in lighter and lighter colours, and finally disappearing in the haze; their fall down to the bottom of the valley is not very steep. The river itself is out of sight. The river-bed appears light grey, but in summer, when at least half the bottom of the valley must be filled the colour is probably a darker grey from the muddy water.

Continuing westwards the road crosses a little brook from Dongka-pu, and goes along the foot-hills, not seldom covered with sand; the rock is here metamorphosed porphyrite. Then again the Tsagulung valley with its village is left behind. The ground is soft and covered with some meagre grass. We touch the north-going bend of the river where Siting is situated. Sometimes ravines are crossed; the further from the mountains the shallower they become. A marked but low erosion terrace follows the northern side of the high-water bed. Now the ground becomes gravelly and sandy with some steppe-vegetation. A promontory consists of biotitic plagioclas-amphibolite; the valley is here anticlinal. Its breadth is about 5 km.; only west of Ta-nak does it become narrower. Again we pass the valley Chomo-tsong, the water-course of which breaks through the terrace; then follows the double Chini valley with village. Here and there are blocks of granite rounded and worn by running water. Sometimes *manis* are seen. The river is not visible from the road.

At some distance to the west the view gets closed by a fairly mighty group with snowfields. Otherwise snow is rare; at the north-side of the valley there is none at all, at the south-side only some narrow stripes in shadowy places. One of the brooks only still contained some rotten ice in spite of the sun. To our left is the village of Kogü, to our right its corn- and wheat-fields, which continue for a considerable part of the road; where the road runs between fields it is protected by earth-walls against the irrigation water. Tangbe is the next village, Lärko a valley above it, and Laku-pu is the next north valley. To the south is seen the comparatively great tributary Gyachin-tse. At some places sand-dunes are formed, as always with the lee-side to the east. The next promontory consists of grey granite, continuing westwards.

Beyond this place there are again cultivated fields, irrigated as usual from the northern tributaries; the villages therefore are placed in the openings of the side-valleys. Only where the fields are situated below the erosion terrace, as near Yangyu, may they partly be watered by canals from the river.

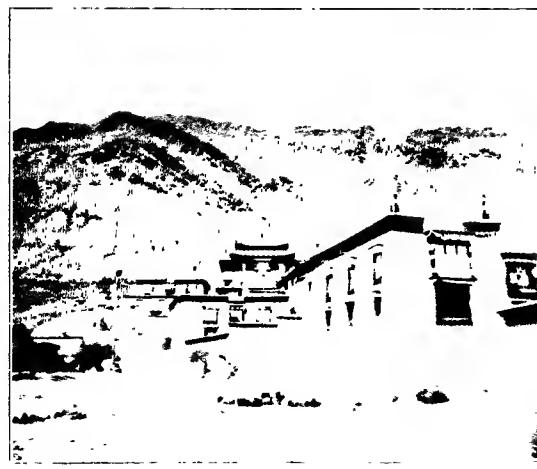
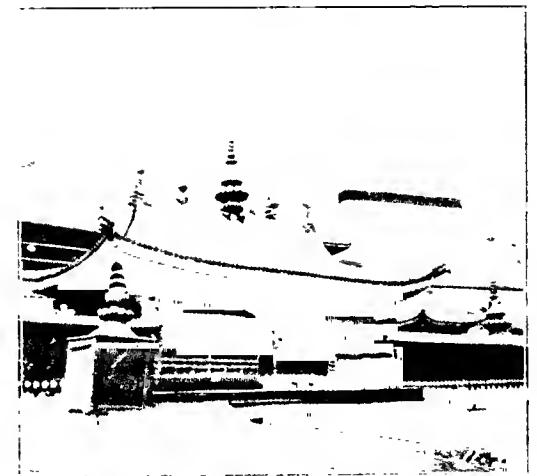
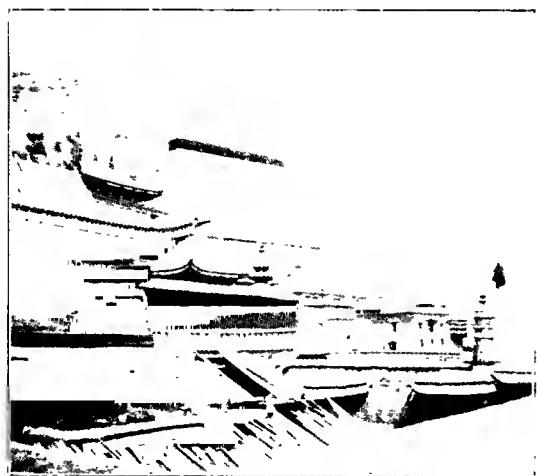
A *mani-rigmo* measured 178 horse-steps in length; these votive-walls cannot be compared with those in Ladak, which are much better built and decorated with finer *mani*-stones. At Lakiya-tang, a promontory of quartzitic mass, the river is

quite near us; a little north branch of the river sweeps immediately along the foot of the rocks; the road is here laid with stones and protected by a low stone wall. The valley and mountain of Changri are left on our right.

We now come up on the hills of gravel and shingle, the foot of which is washed by the Tsangpo, making the slope very steep down to the river. It is on the top of this terrace we again camp at Ta-nakpo. The brook Ta-nakpo-chu had now diminished considerably, to about 5 cub.m., which chiefly seems to depend on the irrigation canals, many of which now stood filled with water from the brook.

Both on my journey down to Shigatse and back to Ye the weather was very windy: hard, westerly wind especially from noon till late in the evening. Riding westward one had this wind straight in the face, and even with well protected eyes it was sometimes impossible to look up. From higher points, as Lamo-tang, the whole valley seemed to be filled with a compact yellow stream of drifting sand-clouds, rushing down over the river-bed to the east. No doubt this annual sand-loaded wind is one of the causes of the general barrenness of the valley. Sand-dunes are also a common phenomenon, and only occasionally does the meagre vegetation get time to bind them. The wind is a second agency assisting the river to work out the valley. The great difference of temperature between winter and summer, day and night, the capillary frost, the barrenness of the rocks, the rains, — everyone of these agencies accelerates the weathering and decomposition of the mountains. The finest detritus is carried away by the wind, and the corrosion of the drifting sand again attacks the hardest rocks. Sand-dunes are formed on the level bottom of the valley, and even between the river-branches. During the high-water season they are again carried away and form new sand-banks lower down the course. These sand-banks get transformed into new dunes. Thus there is a constant wandering of solid material down the valley under the action of wind and water, both tending eastwards. The air, the water, and the solid material, everything is wandering from west to east through this great furrow between the Himalaya and Transhimalaya. From the side-valleys much material is also brought down into the Tsangpo valley; but the tributaries are protected against the wind. The Tsangpo is the great common recipient for wind, water and detritus. In the side-valleys the action of the water is nearly at rest in winter, but in the Tsangpo valley the water always carries out its work, though, of course, on a much greater scale in summer than in winter.

At Karu, on March 30th, I was told that the windy season would continue for another two months. About the middle of May the wheat and peas are sown, and the barley some 10 days later. When the crop is about $\frac{3}{4}$ foot high, the wind has ceased. At the end of June or in the beginning of July the rain sets in, and during the rainy season there is no wind. The amount of rain varies year by year, sometimes it falls in abundance, sometimes only in light showers, and much interrupted by clear weather. In the middle or end of September the harvest is brought in. Just now, or at the end of March, the frozen stretches of the river



VIEWS OF TASHI-LUNG.



LAMAS OF TASHI-LUNPO.

further west began to break up, causing a very slow and hardly observable rise of the river, which was said to continue to more regular rise at the beginning of the rainy season. In July the river is very high, and it is then impossible to travel down to Shigatse on hide-boats on account of the strong current which easily carries the boats against the rocks. In September and October the Tsangpo begins to fall. In cold winters the river freezes so hard that one can walk over on the ice; in other years, as 1907, only quiet and protected places are covered with thin ice for a short time.

At Ta-nak, on February 8th, I obtained the following information. The winter is always very windy and west winds prevail. Usually the valley is filled with dust and drifting sand. In the evening the mountains to the south and north were visible as through a fog, but to the east everything disappeared in the haze; the following morning the weather was nearly clear. The natives still expected some three months' hard wind. The winter of 1907 was said to be warmer than usual; otherwise the river used to be frozen at this time of the season, beginning in February, and getting free from ice only at the end of March. In 1906—1907 it had not been frozen at all. At Ta-nak the Tsangpo was expected to go on sinking for another two months; from the beginning of May it should rise slowly, and from the beginning of June it should rise rapidly. During July, August and September it is at its highest. During the rainy season the whole valley below the terrace is filled by the river. Even during the melting of the ice after a cold winter no particular rise of the river could be observed at Ta-nak, a piece of information that seems to be less reliable than the one given at Karu. For even the Tarim has a very considerable high-water in the spring, and in the upper Tsangpo an enormous quantity of water must be bound in form of ice, and move down as a spring-flood as soon as the temperature becomes sufficiently high.

At Sadung, on March 27th, I was told that the hard western wind used to continue until the middle of May. In the middle of June the new grass comes up, though not yet sufficient for the flocks. The river was expected to remain as it was for another 10 or 15 days, after which it should sink very slowly, a statement that seems to corroborate what I heard at Ta-nak. Only from the end of May was it said to rise; and in July it is at its highest; at the end of September it begins to fall, and at the end of October it should be as low as at present, or at the end of March. Some years the river freezes at Sadung during the night, but breaks up during the day, and it never occurs that it can be crossed on the ice.

CHAPTER XLV.

THE TSANGPO FROM YE TO THE JUNCTION OF THE DOK-CHU.

On April 3rd, 1907, I travelled S.W. from Camp 133, Ye, crossing a little grove of trees, Lundung-changra, several irrigation canals, spread over the fields on the slowly sloping ground, and leaving at the foot of the western mountains the village Devé-chasang, the monastery Gompa-chang, and the village of Tungmön-därap with a distinguished Lama's house called Tungmön-labrang. The mountains to our right are the last ramifications from Transhimalaya; to our left is a small, isolated mountain group, occupying a part of the great widening of Ye. At its western foot is a little monastery Ribu-tinsi, and the village of Shärchen. Kabring is a village on our road. The ground is partly cultivated, partly it consists of finer gravel or yellow clay. Shatsa is a village near the southern promontory of the isolated mountain, the southernmost ramifications of which are seen approaching the Tsangpo. Unsang is a little *gompa* to our right, and Chogo a village near our road. Here the ground is sandy; stones and gravel are removed from the road and form two lines along its sides, as between Spittok and Leh; the whole landscape between Ye and the Tsangpo is in many respects very like the country between Leh and the Indus.

At the village of Devuk we are not far from the river. To our right are hills, and beyond them higher mountains. To the south, beyond the river, is a great plain, though not so wide as the one of Ye-shung. It is bounded to the south by a low ridge beyond which a higher range is seen, and south of this again two high peaks raise their snow-covered heads above their surroundings. The gravel scree at the foot of the northern mountains is sharply bounded; exactly below this boundary are the above-mentioned villages, and below them their fields. Still further down is the alluvial bed of the present Tsangpo.

Kabu-kangsa is a village on the northern bank of the river. Our road now goes up and down over gravelly slopes and ravines, and below us are the meandering branches of the Tsangpo. Looking east one sees how the valley gets more and

more narrow towards Shigatse, and westwards one sees how it dwindles to a mere gorge. Gyang-la, 4130m. (13,546 feet), is a little hill-pass on the road, Milung-nangbe a village in the opening of a double valley to our right. At the village of Hlavang-tse we are surrounded on all sides by low hills limiting the view. *Manirigmos* are often seen. From the village the road goes steep down through a gorge to a tributary from the N.W., also called Hlavang, and joining the Tsangpo to our left. The rocks consist of grey granite.

Just below the point where we reach the very bank of the river, there is a rope bridge, Chaok, spanned between two small rocks, proving that even the high-water of the rainy season gets room within this narrow space; the bridge was regarded as unreliable, and is not in use. Above this place the Tsangpo flows in one compact branch, and is about 50m. broad; the water is clear and of green colour; the current is slow, there are no rapids, except just below the bridge; there is no ice at all, and no snow. The southern mountains are higher than the northern. The ground is soft, yellow clay, and there is some vegetation of dry hard bushes and steppe plants. For some distance there is a narrow plain along the northern side of the river, partly covered with gravel, and pierced by dry ravines from the northern tributary valleys. At the south bank the mountain slopes stand close to the river; the edges of the gravelly fans from the small transverse valleys are often cut off by the high-water of the Tsangpo, thus forming sharp terraces towards the river. Here, as on the way to Shigatse the Tsangpo shows a decided tendency to keep to the southern side of the valley. Turning east one sees how the river goes out from its narrow passage to the wide plains of Ye, as coming from a street to an open square.

Just below Pusum the Tsangpo is very narrow, some 30m., and here, in a bend, the water forms murmuring rapids, which, however, are no hindrance to the hide-boats. Pusum is situated on the gravelly fan from a northern tributary, Ngolung, and at a height of 4,062m. (13,323 feet), being some 60 m. above the water level. The northern hills are of soft material, cut through by deep ravines, often with nearly perpendicular slopes, as if they had been formed by landslips after heavy rains. The mountains at the southern bank have a steep fall to the river bed. In a southern tributary a road goes up to Golema-gompa, one day distant. A mountain to the S.W., ascended by Ryder's expedition, is called Nayala, another, further west, Ombo-tong.

The natives of Pusum expected that the river from now during one month would rise a little on account of ice melting further west. As soon as this ice-water has passed Pusum there is a slight fall in the river which is succeeded by the definite rise of the summer. In opposition to the information given lower down the inhabitants asserted that hide-boats were used from Pusum the whole way to Shigatse, even during the high-water period.

From Pusum the road follows immediately along the river; the rocks are grey granite. Already east of Pusum Pindsoling is seen on its rock, like an old castle

on the Rhine. Still the valley is narrow; the roads on each side are situated in the slopes, and sometimes forced down to the very bank by promontories of rock. Sometimes, at the southern side, the road is built some 40m. above the water-level along the very rock. Beyond the village Tse, situated in the opening of a northern tributary, our path is full of gravel; the valley is here about 400m. broad, but then a southern tributary comes out with a great fan sloping some 10° to the main valley which therefore becomes wider. At its junction the Tse brook forms an acute angle with the main river the wrong way, an irregularity which is common in this hydrographic system. At one place the Tsangpo sweeps along the northern side of the valley, and here the road, laid with stones, runs nearly at the same level with the water, and, sometimes a few metres above it. A little further on the granite rocks fall nearly perpendicular into the river, and one has to ride in the water; the bed is hard sand; the summer-road crosses the cliffs. Here the river is very narrow and forms small rapids, but just above the place it is a wide, dark and deep basin, with a very slow current.

Beyond the narrow passage the valley may be 800m. wide, and there is more space on the north side, where a few bushes grow. Gisü-pu is a northern tributary the fan of which goes down to the very river. Chujung is a gorge from the south. At Tangnak the Tsangpo again touches the northern side and forces the road down to the river. At the southern side is the village of Mingi with some huts, gardens and fields, and a sharply marked erosion terrace. Sometimes the Tsangpo is up to 100m. broad. Still the valley is so narrow that even the high-water cannot make the river much broader than it was now. At flat wide places, such as Ye, the valley must look like a lake when the high-water comes down.

At Chaga, a village of a few huts, the height is 4,012m. (13,159 feet). Opposite is Pindsoling on its rocky ridge. Here is a *chaksam* or iron-chain bridge, in a bad state of repair and not in use. The inhabitants of Chaga said that the river, from now, would rise a little from the melting of river-ice further west; if the weather remains clear and warm for some days this rise becomes stronger. In the beginning of June the river should stand about 2m. higher than at present. At the beginning of August the water-level should nearly touch the chains of the bridge, which, at their lower part, seemed to be some 5 or 6m. above the water. This happens only in very rainy summers and for 10 days or two weeks. At the beginning of October the Tsangpo was said to be still 2m. higher than now, at the beginning of April. Even in the first days of November it stands higher than in April, and only the beginning of December will see it go down to the present level, and then freeze. It was said never to become lower than in April and December, which seems unlikely, for much water must be bound during January and February.

At Chaga the current is so strong that the Tsangpo never freezes all the way across; even during very cold winters there is an open channel in the middle. Hide-boats go down to Shigatse in 4 or 5 days now, in 2 or 3 days in summer, and



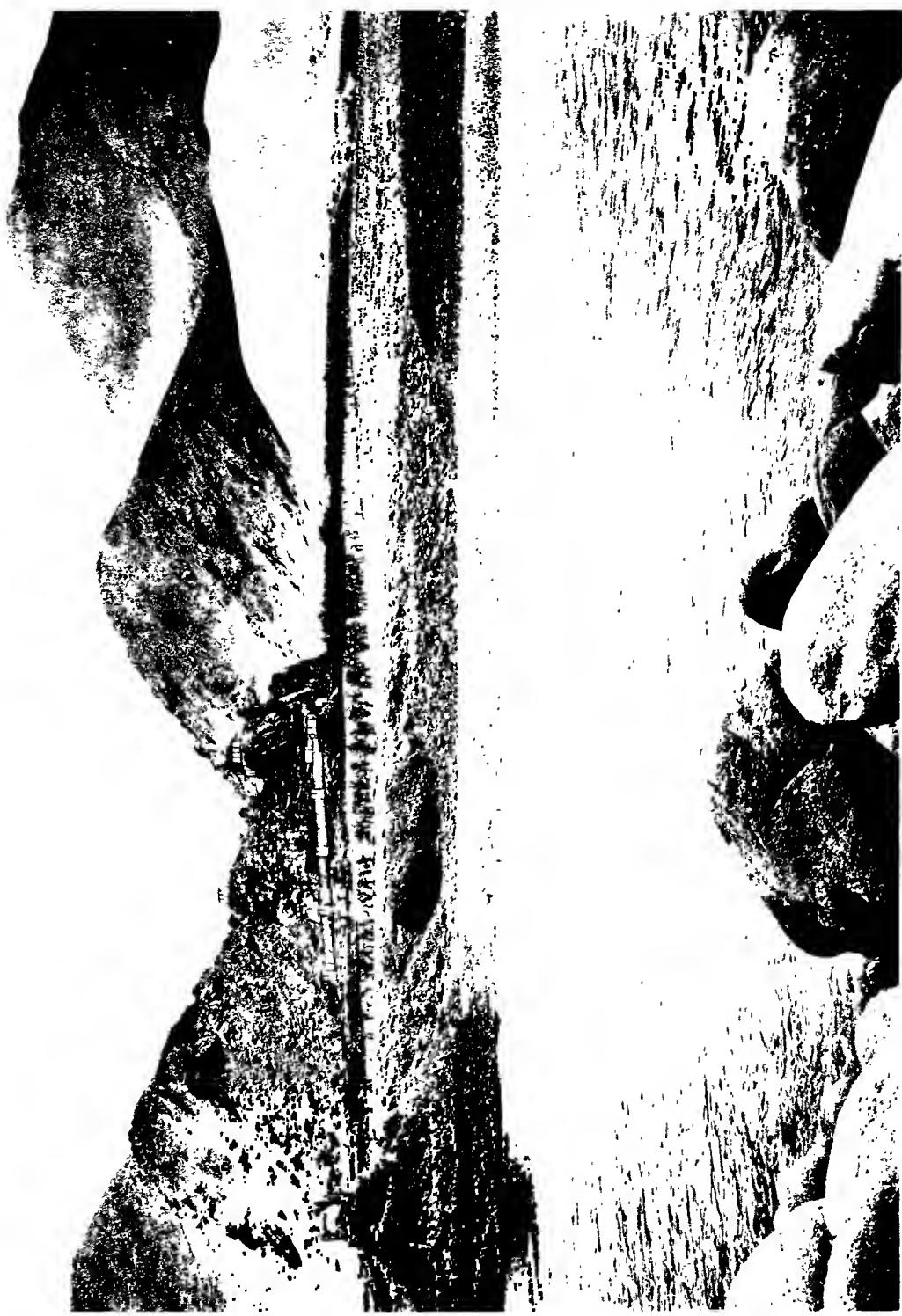
MY CHINESE AND TIBETAN GUARDS AT CHAGA.



THE BRIDGE BETWEEN CHAGA AND PINDSOLING.

THE BRITISH BRITAIN CHAGAS AND PINDOLIN.





PINDOLING-GOMPA ON THE SOUTHERN BANK OF THE TSANGPO.



FIG. PSANGPO VI CHAWA, LOOKING WEST.

the boatmen I spoke to asserted there was less danger in summer when banks and rocks in the bed are avoided. Now there were no boats at Chaga, and as the bridge could not be trusted, passengers to Pindsoling had to take the road over Latse. When I asked from where the Damchok-kamba, as they called the river, came, they answered: from the Gangri, six months to the west. From Pindsoling to Latse and further west Ryder followed the southern bank of the Tsangpo.

To the S. 71° E. the valley offers a picturesque perspective, with Mount Chaong-la in the background. S. 22° E. is Mount Nagya; on the ridge originating from Nagya is the *dsong* of Pindsoling, S. 4° W. from Chaga. Beyond this ridge, or S. 4° E., is a peak Gunje-dubuk; to the right of it is a pass Tarkung-la; south of the pass is a region Chuarung, inhabited by nomads. Between Tarkung-la and Pindsoling is said to be a valley called Chonang with a monastery Chonang-gompa; S. 28° W. is a peak Ngombo-chong. Just above Chaga the Tsangpo goes through a narrow passage, Chibuk, where there is no room for the road to Dok-chu and Raga-tsangpo. The road therefore has to cross a little pass Chikchung-chang in a ridge from the north; a gorge in the N.W. leads to the pass.

Grey granite prevails. At Chaga on the northern bank of the Tsangpo there are innumerable granite boulders of all sizes, generally about one meter across; the ground is sandy. A curious sand-dune, called Chiri is formed on the eastern, or lee-side, of the ridge W.S.W., a work of the west-wind; it begins just below the crest and describes a regular curve down to near the river. It is of course stationary, constantly fed by the west-wind, and again diminished by the same wind. It is as a station for the drifting sand on its way down the valley, and its form, size and situation is a result of eternal physical laws. Several other mountain sides in the neighbourhood are covered by dunes and look striped like tiger-skins. Both at Pusum and Chaga I noticed in the evening and night a very strong and hard wind blowing down in the valley like cascades from above.

From Chaga our road goes up the dry narrow gorge to Chikchung-chang, on the pass of which a *hla* is built above the precipice of the valley. The road to Latse follows immediately along the river, some 10m. above its level, and at the side of steep mountains with a peak called Doombi-tang and visible to the S. 67° W. from the pass. A peak to the S. 81° W. is called Karong, another to the N. 83° W. Damboo-richen. The road down from the pass is very steep and unpleasant. The level bottom of the valley may be one mile broad, and is covered with gravel and sand.

At the foot of Doombi-tang is the important point where the Tsangpo comes from S.W. between steep picturesque rocks, and joins the Dok-chu, coming from the west, and called Raga-tsangpo above the junction with the Mü-chu. The height is 4,013m. (13,163 feet). On April 6th I measured the volume of both rivers.

The Dok-chu was divided into two branches. In the greatest of these the depth was measured at 11 points and gave an average of 0.7sm., the maximum depth

being 1.03m.¹ The average velocity measured at 32 points, at the surface, in the middle, and near the bottom, was 0.508m. a second. The breadth of the branch was 54m.; and the volume amounted to 21.38cub.m. a second.

The second branch had an average depth of 0.40m., an average velocity of 1.39m. a second, a breadth of 15.30m., and a volume of 8.54cub.m. a second. The whole Dok-chu therefore carried 29.92cub.m., or in round figures, 30cub.m. a second.

The Tsangpo itself presented some difficulties on account of the very great depth and the slow current. At the place where the rope was spanned across the river and the boat held at equal distances for measuring depth and velocity, the breadth was only 46m. The depth measured at 10 places along this line was on an average 2.82m., the deepest being 4.67m. The average velocity was 0.578m. a second, and the volume 74.98cub.m., or in round figures 75cub.m. a second. To this is, however, to be noted that the velocity instrument could not be held steady any deeper than 2m.; therefore I calculated a regular diminution of velocity towards the bottom, and perhaps in reality the current may be stronger somewhere near the bottom. The following measurements on the river will prove, however, that the value of 75cub.m. was very likely correct.

The whole Tsangpo, below the junction with the Dok-chu-Raga-tsangpo had thus a volume of 105 cub.m., and must have increased on its way to Shigatse to at least 125cub.m., after having received several tributaries, the greatest of which were Soo, Shab and Ta-nakpo-chu.

Below the point where the Dok-chu was measured it splits up in several delta branches spread over the gravelly bed and rushes murinuring down to the quiet and silent Tsangpo, which sweeps immediately along the rocks at its right bank.

¹ After introducing some corrections to the first calculations the results differ somewhat from those published in *Trans-Himalaya*, Vol. I.

CHAPTER XLVI.

THE TSANGPO AND THE CHAKTAK-TSANGPO.

From my Camp 167, Kyärkyä, I travelled, on May 28th, 1907, again down to the Tsangpo, and had an opportunity to see a part of the valley never described before, as both Nain Sing and Ryder travelled north of this route.

The road follows the Gyäbuk valley due south. At the first right tributary, Pungre, sandstone stands in living rock; Nakboche is a left, Chunchar a right tributary to the Pungre. Gaktsa, Mendong-kungma, and Mendong-ok are also small tributaries from the right side. On a rock on the same side are the ruins of the nunnery Yüüpar, and below it the ruins of the village of the same name; there are several ruins and abandoned cornfields in this valley, which in old times must have been well populated; there are also *chortens* and some *mani-rigmos*: the last ruin is called Chandö. A little brook goes down the valley.

Finally the perspective opens out, and the magnificent valley of the Tsangpo is again before us. From the south enters a rather great right tributary, Samdeling, joining the Tsangpo a little below the point where we reached the river. A road from Tsongka-dsong comes down the Samdeling, and therefore a ferry serves the communication over the Tsangpo; this road continues to Saka-dsong. Corn is carried on yaks from Tsongka, and paid for at Saka with salt from the north; from the Tsangpo it is only two days' journey to Tsongka.

In the corner where our road turns W.S.W. along the northern bank of the Tsangpo is a grotto with Buddha images called Tusang-tangne. The valley may be 500m. broad, and is bounded by moderate mountains mostly of soft material; the living rock is calcareous schist. Shushulung is a little valley from the north, opening to the level ground which, with a breadth of some 150m., here follows the river; there is a strip of level ground along the southern bank as well. The river flows in one strong bed, and has a 4m. high erosion terrace, at the foot of which we pass amongst grass and gravel; this terrace is often interrupted by ravines. The colour of the water is greenish, though it is muddy; the current is slow and silent, without rapids.

In front of us is a more dominating mountain group situated between the Tsangpo and the Chaktak-tsangpo. Mille is the name of a southern tributary, in the background of which is a ridge with some snow. At Tusang-tö two small cairns with flags mark another ferry-place, now not in use; here the valley may be 300 or 400m. wide. Above this place the living rock is graywacke-sandstone. The road ascends a terrace, the foot of which is washed by the high-water; now a wide part of the bed is dry. In July the river must be some three or four times as broad as now at this place.

Then to our left opens out the picturesque rocky gate through which the Tsangpo comes flowing from the S.S.W. to meet its tributary the Chaktak-tsangpo. The mountains at the right side of this passage are called Unggung; in the background of the passage is seen a snow-covered mountain Apchema, said to be in the district of Tsongka. Älung-tangne is a low threshold crossed by our road; here the rock is quartz. Camp 168 was pitched on the very point between both rivers, a place inundated in summer. The absolute height was 4,524m. (14,839 feet), or 511m. higher than at the entrance of Raga-tsangpo, 305 km. lower down.

On May 28th the Chaktak-tsangpo had a breadth of 28.1m., a maximum depth of 0.73m., an average depth of 0.48m., an average velocity of 1.39m. a second, and a volume of 18.8cub.m. a second.

The river had a temperature of +9.9° at 3 P. M., the Tsangpo +9.4° at the same time. At the confluence the bed of the Chaktak-tsangpo is very regularly built, and its current much quicker than that of the Tsangpo. The almost perfectly clear water of the tributary therefore forces itself out a long way into the muddy grey water of the main river. The latter could not be measured at the very confluence as the breadth was too great for spanning a rope across, so I had to take the boat up the river to a place where the Tsangpo was divided into two shallow and very regular branches separated by a long narrow and flat sandbank. Here, at the left bank the living rock was sandstone, and the river, so far as could be seen, came from the S.20°W.

The measurement was carried out on May 29th, and gives as results, for the first branch: breadth = 53.43m.; maximum depth = 1.04m.; average depth = 0.634m.; average velocity = 0.728m. a second; volume of water = 24.7cub.m. a second. The second branch: breadth = 54.93m.; maximum depth = 1.15m.; average depth = 0.728m.; average velocity = 1.176m. a second, and volume = 47.0cub.m. a second. It is curious to observe the great difference of velocity in the two branches, the right one being so much quicker.

The Tsangpo had thus 71.7cub.m. a second, or 90.5cub.m. after the junction with the Chaktak-tsangpo. The form of the bed is very different from that we found at the confluence with the Dok-chu, which is not surprising, as the bed changes constantly, though, as a rule, it becomes narrower and deeper towards the east on its way from the plateau-land to the periferic regions.

At the Chaktak junction the river had 90.5cub.m.; at the Dok-chu junction, 305 km. lower down, only 75cub.m.; though many tributaries are received on the way. The difference of course depends on the fact that the river was measured at the latter place 53 days before the measurement at the Chaktak junction; it should also be remembered that all the northern tributaries from the Transhimalaya are caught by Raga-tsangpo. From the result we get an absolute proof that the Tsangpo constantly rises from day to day during April and May, a rise which, of course, continues the whole summer till the absolute maximum is reached.

A small oscillation of the water level of the Tsangpo could be observed. In the morning of May 29th it stood 25mm. lower than at 3 P. M. the day before; at 3 P. M. on 29th it had again risen, and stood 15mm. higher than 24 hours before. This must chiefly depend upon the local weather, and the different speed of melting day and night in the nearest tributaries.

From Camp 168 our road follows the northern bank of Chaktak-tsangpo N.W. and W.N.W.-wards below or on the top of its 5m. high terrace. The valley is level to the eye and the current very slow, having no rapids at all. Once or twice the river is divided into two or three arms. The valley is broad and open, about 1 km., and surrounded by rather low mountains, a series of shoulders, generally with some living rock visible, green schist, either at the base or as ridges on the crest. The Chaktak-tsangpo is here enclosed between two ridges with short transverse valleys, a few of them with brooks.

From the left, or north, we observe the following tributaries: Ahlung-rong, Chang-lung, Muga with a brook forming a little delta at the junction, and coming from a considerable mountain group in the background; Pelung-ongma, Pelung-kongma, and Nimdong. Tögden is a promontory just below Camp 169. From the right or south enter the tributaries: Kha, Tingring, Kera-lung, and Gulung. There are some good pasture-grounds in the valley and bushes grow at a few places; at Nimdong were two tents and flocks of sheep and goats. There is not much gravel, but a good deal of sand, either forming rudimentary dunes, or terraces with steep sides, and grass on the top. Kyangs are common. *Mani-rigmos*, *chortens* and ruins are often seen along this road which seems to have been very much frequented; the walls and towers on some hills are probably remains of fortifications from times of hostility with Nepel.

A half storm was blowing from the west the whole day, and the air filled with dust.

From Camp 169, at 4,525m. (14,842 feet), we again leave the Chaktak-tsangpo, and ride up the Takbur valley to the N.N.W., and then turn N.N.E. rising considerably. This valley is rich both in grass, bushes, water, and wild animals, such as kyangs, foxes, lynxes, hares, arctomys, rabbits, partridges, pheasants and small birds. Great flocks of tame yaks are seen. Near the pass a few snow-patches may still be seen in shady places.

The pass Takbur-la, 5,066m. (16,616 feet) high, is situated in the little range which separates the Chaktak-tsangpo from its left tributary Sa-chu, and which I had crossed a few days before; further east is Gyäbuk-la, only 4,823m. (15,819 feet) high; further west it has two other passes, Sering-la and Lamlung-la.

The view from Takbur-la reaches far, and it was a pity that just here I had no guide. To the N.W. some high snowy peaks were seen, the Lunpo-gangri, which I should approach, a year later, from the north. To the N. 38° W. a low part was seen in the mountains, which I suspected to be the valley of Chaktak-tsangpo. A range with some snow, culminating in N. 29° W. appeared to be the continuation of the Lunpo-gangri. To the N. 19° and 13° W. were two low peaks belonging to a black group, Shinchen, on the northern side of Sa-chu. To the north and N.N.E. was a high range with eternal snow on several peaks, the highest in N. 1° E., belonging to the Kanchung-gangri.

Takbur-la is situated in quartzitic sandstone. The valley which from the pass goes down N.N.W. is first broad, and falls in curious rounded terraces or steps, each 4 or 5m. high. Then it becomes narrower and is bounded by hills. At a place called Karkong-sumdo, with 2 tents, the valley joins the Lamlung coming down from the Lamlung-la. The joint valley, called Karkong, then becomes fairly large, especially after receiving the great Shepuk valley from the right or east. A part of the valley has an extraordinary formation, viz. a long narrow ridge, 8 or 10m. high, and 10m. broad on its top, on which the road runs; there are brooks on both sides of this little ridge; lower down the joint brook follows the right side of the valley. Quartz and green schist prevail. The pasture is excellent and many hundred yaks were grazing in the Karkong valley.

Finally the road turns to the right over a last projecting ridge, from which one has a splendid view over the Sa-chu valley with its great plains and its surrounding moderate mountains. To the N. 85° E. and S. 89° E. two culminating peaks of the Chomo-uchong massive are visible. Four tents were pitched in this tract of the plain. Passing them our road crosses the plain diagonally to the E.N.E.; the Sa-chu now contained only half a cubic metre of water. At its northern side is Saka-dsong, the principal place of the province of the same name, consisting of a few huts and tents and a little *gompa*. The height is 4,616m. (15,140 feet).

From Saka-dsong to Nyuku Nain Sing followed the *tasam* or highroad; Ryder and Rawling's expedition went in two parties, one along the *tasam*, the other south-westwards to the great Tsangpo. To avoid known country I took a northern road amongst the mountains. Only the first day I had to follow the same way as the two earlier expeditions.

This road follows the foot of the northern mountains, consisting of green schist and quartz. To our right is the broad and open valley of the Sa-chu with its right side terrace and its meandering course; sometimes the river-bed forces the road to keep to the slopes. At Upa-tang the Sa-chu flows in one single bed. The fall is



A PAGE OF THE CHIOMO-UCHONG, FROM CAMP 164

slow, and only at projecting capes small rapids appear. Further west the river crosses the valley diagonally, and goes down to the Chaktak-tsangpo. The valley may be one km. broad but gets wider westwards. Beyond Kumba-nädik the road comes down from the hills to the level plain.

Choro-dong is a promontory from the northern mountains, consisting of mica-schist with quartz veins. Here as elsewhere *mani-rigmos* are common. A northern peak is called Tingoa or Tingo-shar. Turning north-westwards we camp just below Targyaling-gompa, at a height of 4,574m. (15,003 feet).

The following names were given on the northern side of the valley, from east to west: Mount Kamsang, the valleys of Shinchen, Japsang, Shalung and Shalung-nooma; Kumba-nädik, a valley with surrounding mountains; Pema-lungchung, a small valley; Salak, a valley leading to a small pass Tashik-la with a direct road to Pasa-guk on the Chaktak-tsangpo. At the southern side we notice: Chiblung, a dominating mountain; Changulung, mountain and valley; Karkong, the valley we had used from Tarbuk-la; Nalung-charang, Tingring, and Dongo valleys.

From the Camp one sees to the south in the background of the Chaktak valley some snowy ranges on the southern side of the Tsangpo. To the S.S.W. the Chaktak-tsangpo goes down, first southwards, then turning S.E.; two of its right tributaries, Chopang and Kilung are seen; at the right side of the river, to the S.W. is a mountain called Nanta. To the S.80°W. is Hlalung, a valley in which the *tasam* runs. The spur on which Targyaling-gompa is built is called Gompa-gäbri. To the N.N.E. is Tingoa with the valleys of Tsalung and Salak.

I was told that no boat was used on the Chaktak-tsangpo; if the river, after heavy rains becomes disagreeable, it happens that caravans on the *tasam* have to wait. In December and January last two feet of snow had fallen, but quickly disappeared. In the beginning or middle of July rain was expected; sometimes in summer strong hail showers came down. This year there had been very little precipitation. The hard wind we had met near Shigatse had now ceased, though it could be rather windy sometimes, nearly always from the west.

A short distance westwards takes us to the broad valley of Chaktak-tsangpo; the river is divided in several branches, and the water muddy, though we had seen it perfectly clear at its junction with the Tsangpo. Along the left bank of the river our direction now becomes N.N.E.; in the corner calcareous conglomerate stands in living rock. To our left is a Mount Nimdong. The road goes on the top of a terrace full of gravel and blocks, with the river, in one bed, at its foot. There are no rapids. The valley may be some 300m. wide. It is very arid. Northwards it becomes wider; the road from Tashik-la joins our road from the right.

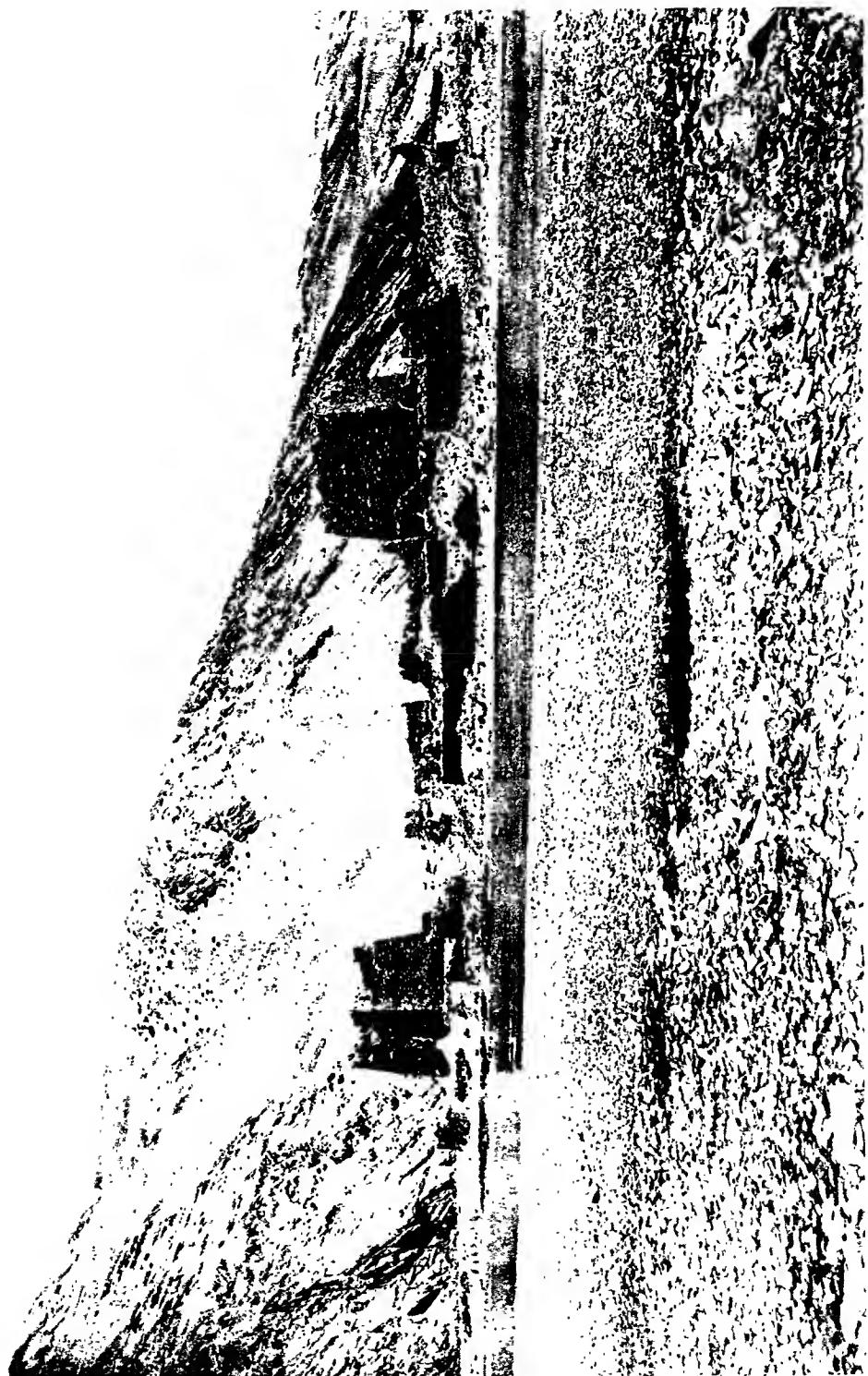
The village of Pasa-guk, on the right bank, is at a height of 4,586m. (15,042 feet), only 55m. higher than the junction of Chaktak-tsangpo and Tsangpo, showing a very slow fall. On June 8th the river was here 43m. broad, with a maximum depth of 0.780m., an average depth of 0.418m., an average velocity of 0.991m., and a volume

of 17.8cub.m. a second. The Chaktak-tsangpo had thus now 1cub.m. less water than 12 days earlier at the confluence with the Tsangpo. One would perhaps have expected more water as the season was approaching the maximum of the activity in the Tibetan rivers. But, on the other hand, it should be remembered that on the way from Pasa-guk to the junction the river receives several tributaries, and further, that the summer of 1907 was very dry and the clear weather nearly constant, so that the melting of snow and ice did not show any acceleration in the beginning of May.

A daily period of oscillations could be observed in the water-level. On June 8th, 12.30 P. M. I had a mark fastened near the bank *au niveau* with the water level; at 4.30 P. M. the same day the level had fallen 25mm.; at 7 A. M. on the 9th it stood + 53mm.; 9 A. M. + 33, 10.30 A. M. + 17mm., 1 P. M. — 25mm., 4 P. M. — 45m.; the river then continued to fall in the evening and perhaps a part of the night, and rose the next morning. The amplitude cannot be great as the river comes from a lake, Lapchung-tso, and is to a great extent fed by springs, but it shows the difference in the rate of melting during day and night in the upper reaches of some of its tributaries entering below Lapchung-tso.

Pasa-guk is a miserable little place of a few huts and tents and some poor inhabitants, but still it is a kind of emporium for salt from depressions and lakes on the northern plateau-land, and later in the summer a market is held here.

THE VILLAGE OF SHRI-LANGDO WITH ITS TWO TOWERS ON THE CHAMPAK MOUNTAIN



CHAPTER XLVII.

FROM PASA-GUK TO TRADUM AND THENCE TO THE CONFLUENCE OF TSA-CHU-TSANGPO WITH THE TSANGPO.

From Pasa-guk our road goes westwards along the southern branch of the Chaktak-tsangpo. The ground is either sandy or covered with gravel and small blocks of crystalline schist. A projecting rock, Agar-jagar, consists of marble, and has a ruin on its top. A little higher up, where the river comes out of a narrow passage, there are the ruins of a whole village, Shiri-tangdö, two towers of stone walls, dilapidated houses, etc., said to have belonged to Saka-dsong at a time when, this place was at war with a mighty Lama dwelling in the mountains here about. There are many *manis* round the place.

North of this old village is a pass, Tsangdong-la, with a road to a higher part of the Chaktak-tsangpo. The rocky promontory above the village is called Sami-yang. Chago is a steep, short, and dry tributary from the right, and Chago-pumpa-ri are the mountains round it.

The Chaktak-tsangpo runs in one branch between terraces, 5 or 6m. high, and in two or three stories; at the right side an older terrace is some 10m. above the river. The fall of the valley is very slow, and at rare intervals small rapids are found in sharp bends. A little further west we leave the transverse valley through which the Chaktak-tsangpo comes out from the N.E.; in the background are seen some not very high snowy mountains and peaks, here called Lap-känchung, a name obviously combined of Lapchung and Kanchung, with which as well as with the upper course of the river we shall make nearer acquaintance later on. This Lap-känchung corresponds to the Lapchung-gangri. The information I got of the upper reaches of the river proved to be useless; even the Lapchung-tso was unknown. The transverse valley of the Chaktak-tsangpo which we now leave to our right, is pierced through the range that lies S.W. of and parallel with the Lunpo-gangri.

Then our road follows the course of the right tributary Rok, which joins the Chaktak-tsangpo just at the southern foot of Mount Demok; south of the junction the mountains are called Pangchen; where the two valleys meet a triangular plain

is formed, which gets inundated after heavy rains. Along the right bank of the river the erosion terrace is sharply marked, and consists, at its continuation along the Chaktak, of blocks; the left terrace is more interrupted. The ground is soft and easy with many signs of nomads' camps. Changta and Kara are small tributaries from the south.

The valley becomes wider; Tsakung enters from the south; opposite it the Chilung comes from the north. Chakta is a rocky promontory at the northern side consisting of mica-quartzite. The brook of Rok comes from a southern valley, Markyem, in the background of which is visible a little range with some snow: on its southern side runs the *tasam* or high road. Shulung, Pangbuk, and Kyangjung are valleys, and Teta a pasture-ground in the upper regions of Markyem. Camp 173, Churu, is at 4,628m. (15,180 feet). To the N.83°W. is an open valley, Parpa, with Pugu-ri south of it; N.70°W. is a fairly high mountain Thakta, with some snow to the N.E. Sangya and Motaga are small valleys from the north.

The road continues westwards in the same latitudinal valley as before, parallel with the valley of the Tsangpo. A short distance west of Churu is a flat threshold, not noticeable to the naked eye, but still important as being the watershed between the Chaktak-tsangpo and the Men-chu. South of it issues the Tagelung-karmo; Rok-parpa is one of its tributaries. The northern mountains are of moderate height and pierced by several nameless gorges and ravines.

From the south enters the Serkyalung; Ta-chebur is a steep rock to our left; Kangmar a gorge from the north. By and by a little meandering brook appears in the valley; the ground is soft, with grass, swamps and pools; 14 tents were pitched at different places, surrounded by flocks of sheep, yaks and ponies; the road is well frequented as many pilgrims return this way from the Kailas, thus completing a *kora* or round wandering by the journey itself. Shägo is a southern tributary with two moderate peaks in its background. Camp 174, Rok-shung, is at 4,609m. (15,118 feet). The rock is phyllitic schist.

Following the brook we now keep to the S.W. The northern mountains rise in height; a snow-covered peak to the N.38°W. is called Chuka-turbung, and one to the N.41°W. Yundung-tsepke. At the left side of the valley the rock is quartz. Down through a left tributary, Tangchen, the *tasam* comes down and joins our road at the foot of the southern mountains. Dangjung is a tributary from the south, Logolaga a small but dominating peak on the same side.

Our brook joins the Men-chu, coming from the N.W.; east of the junction the rock is crystalline sandstone, and west of it quartzitic sandstone. In the angle between both brooks is a mighty rocky group of mountains; at the confluence is Nyuku-tasam with a little house for the chief of the district. The height is 4,600m. (15,088 feet)

Following the Men-chu which carried some 3cub.m. a second, the road turns N.W. The brook is rather sinuous, the valley narrow with its bottom covered by gravel and grass. The right hand terrace is 4 or 5m. high; the rock consists of

sandstone and schist. Many tributaries enter from both sides; from the right or S.W. we pass: Lublung, Pang-ningri, Tingring, Gukchen, Panglung-marmo, Tsukchung with steep rocks on its left side, Tsukchen, comparatively great with a road over Tsukchen-la to the *tasam*, and finally Kyam-ngoya. From the left or N.E.: Serchung, Sara-nakto, a great valley with fairly high mountains in its background, Sanga-lung and Kanda with road to a pass Kargong-la; another Sanga-lung comes down at Camp 176, where the region is known as Kyam-ngoya, 4,670m. (15,318 feet). Here 15 tents and great flocks were seen.

Continuing in the same direction the road runs at some distance from the Men-chu, on the top of its left hand terrace. From the road one has a fine view to the S.W. over the bottom of the valley with its tents and flocks and its meandering brook; the valley is well populated; as a rule I found more population in the small hidden side-valleys north of the Tsangpo, than along the Tsangpo itself; at Tamashär, for instance, were pitched more than a dozen tents with great flocks.

The valley may be some 8km. broad; the road is good and, as usual, decorated with *mani* walls. The gravel is often gneiss coming from higher regions. On the right or S.W. side we notice the small valleys Gablung, Tsalung-karo, Täshi, Gungö with a pass, and Särehung. On the left or N.E. side: Saser a great valley between wild and steep rocks, Chang-la-tak a hill at the foot of high mountains, and Chäjung a small valley.

Camp 177 is situated at a brook, Konak, a northern tributary to the Men-chu, and at a height of 4,729m. (15,511 feet). I was told here that the considerable range we saw to the north was pierced by Rukyok-chu, a right tributary to the Chaktak-tsangpo, and that a range farther north was the water-parting between the Tsangpo and the plateau-land. This proves how much native information is to be relied upon; a year later I should get an opportunity to see the country myself.

To the N.23°W. from this camp there is a broad and open valley with a small snowy peak in its background; N.11°E. is a peak in the nearest range called Chashung-kang; to the right or east of it is the valley of Kilung and Kilung-nagmo; to the N.30°E. is a peak from the top of which the whole world is visible, as the Tibetans put it; that peak is identical with Wood's 23,150 feet peak, and is here called Lombo-kangra, the Lunpo- or Lumpo-gangri of the northern nomads. To the N.47°E. is a snowy peak Tsumo-sorayang, visible beyond and above the nearest range. On the latter is Shäkyung a peak to the N.56°E., and to the right of it is the valley of Tsalung. To the S.E. is Mount Kotsang, and to the S.67°W. a valley named Kepo-lung.

From Camp 177 I made an excursion to the foot of the nearest range to the north. The slowly rising ground is spongy, well grassed and pierced by millions of rabbit holes. Further on there is a good deal of granite and gneiss gravel, and ridges of the same material, probably old deformed moraines. Puttuk is a little valley crossed by one road, and goes with several ravines to the chief water-course Kilung.

From a hill, Kilung-la, at 5,318m. (17,443 feet) one gets a splendid view of the mountains; the Kilung-karmo comes from the N.E.; in its background rises the three-headed peak of the same name. From the north comes Kilung-nagmo, said to have its sources at the southern side of the Lunpo-gangri, where small glaciers are seen. To the N.N.W. is the valley of Tok-sumchen. To the W. and N.W. my guide did not know the country, and had only heard that it was inhabited by »the Tradum-tribe Sokpo-chumgor». It may be regarded as certain that the Tsa-chu-tsangpo gets most of its water from the S.W. side of the Lunpo-gangri and its N.W. continuation, Lunkar. From the S.E. side of Lunpo-gangri the Rukyok-tsangpo goes to the Chaktak-tsangpo. The Lunpo-gangri ranges include some of the highest peaks of the Transhimalaya, and from its snows and glaciers much water reaches the Tsangpo. Seen from the Kilung-la the Lunpo-gangri represents an insurmountable wall of steep rocky mountains, and the Tibetans pretend there is no possibility of crossing them. The upper part of the Kilung-karmo is a wild narrow gorge between steep rocks. The living rock is here fine-grained gneiss, quartz-mica-porphyry and grey porphyrite. The panorama I drew will give an idea of the general view. The animal life was represented by kyangs, antelopes, hares, wolves and wild yaks; of the latter a herd of 30 head was seen just under the edge of the eternal snow.

From Camp 177 our road leads W.S.W. up the valley to Särchung-la; the upper course of Men-chu is left to our right, coming from the N.W. The rock is sandstone. From the south enters a valley Panglung, and from the north Nilung. Higher up the rock is phyllitic schist. The valley gets narrower between low soft hills; from the south Gablung comes in. The last part of the ascent is comparatively steep. The pass Särchung-la, 5,188m. (17,017 feet), is a soft saddle, and the view it presents is magnificent. The highest peak of the Lunpo-gangri again shows itself, N. 38° E., as a brilliant, snow-covered giant with black, rocky crags, and very steep sides, and dominating the whole range; N. 47° E. is its neighbour, partly snow-covered, and with grey and rose tinted sides. The peak to the N. 57° E. is all snow dipping up as from a sea of petrified waves. From it and from a peak to the N. 68° E. small glaciers go down. To get a clear idea of the general orographical arrangement from this point would have been impossible; only the next year should I have an opportunity to explore the different ranges further north.

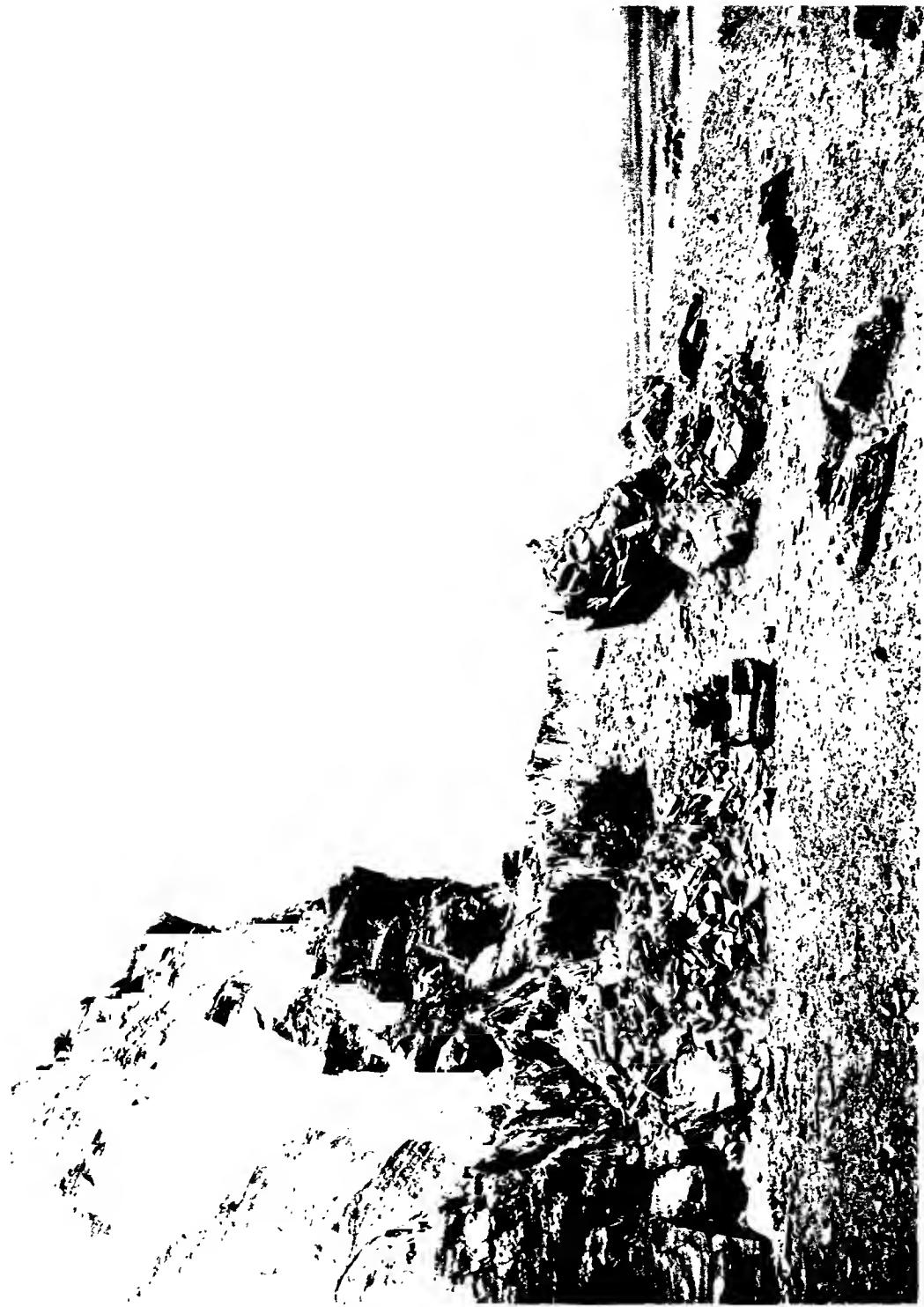
To the S. 40 — 65° W. a particularly high part of the northernmost range of the Himalaya showed its world of snowy peaks and pyramids. North of them is the depression of the Tsangpo valley.

The valley going down to the S.W. from the pass is called Mendelung; it soon widens out to a plain, Tüchu, receiving the right tributaries Yülung, Poguchenga, and Kyang-kere-napko. The village of Tüchu consists of a few stone walls and tents, and is the residency of the *Gova* or chief of the district. The ground is very sandy and the rock is sandstone. To the E.S.E. is the valley of Tingchung-hlonga, through which the *tasam* comes down. The tributary Tükyu-keta enters from the

TRADUM-GOMPA ON THE HILL.



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MANTLES AND FLAGS A FEW MILLS LAST OF TRADUM

north and Tangdi-shalung from the south. Pema-lachung is a pass in the southern range leading to Tradum; its valley is called Yele-ngunchung.

We now follow the northern bank of the Tingchung-hlonga; Serbuk and Ngoalung are tributaries from the north. The valley is very sandy, partly forming dunes 4 to 6m. high. Kugru and Gablung are the next tributaries from south and north. The main valley is fairly narrow, and has some grass and bushes. At Dambak-rong our Camp is at 4,657m. (15,275 feet). The following mountains and valleys are seen from the place: to the S. 15° E. the near peak Pema-lachung-maro; S. 30° W. the valley Gablung; S. 35° W. Mount Shubuk; S. 53° W. Mount Domboche; S. 69° W. Mount Langma-tebo; N.W. the valley of Gonchok; N. 38° W. Mount Nemo-chupgo, and behind it the valley of Gyago-tsang; N. 15° W. Mount Langi-gabri; N. 4° E. the upper Gablung; N. 35° E. the valley of Kamsang; N. 43° E. a Mount Ngombo-yüpta; N. 50° E. the valley of Nilung-ringma; N. 75° E. Mount Nima-lunguse.

The joint brook flows S.W. and west and our road follows it out from the mountains of phyllitic schist and sandstone to the wide valley or steppe of Tsepo, leading to Tradum. Danken is a little hill left to the south; the *tasam* follows the southern side of the valley. Gabuk is a right tributary, and Tuto-pukpa a mountain on the same side. The road continues westwards across very good pasture-grounds, between pools, and touching a black sandstone rock from the northern side, with a cairn full of flags and *mani*-stones; beyond it the valleys of Chingo-ongma and Chingo-kongma come from the north. The last part of the road proceeds between sand-dunes, more or less bound by vegetation; the road is sometimes like a river-bed 12m. broad and 1 or 1 $\frac{1}{2}$ m. deep in the sandy ground.

The height of Tradum is 4,591m. (15,058 feet). Tradum-gompa is built on a little rock of quartzitic schist and sandstone. The view reaches far over the Tsangpo valley to the south and the northern Himalaya range, the highest part of which is to the S. 5° E. and called Jatin; other high groups are Gapo-tonak and Mubo-garang to the S. 33° W. and S. 44° W.; Gaum is a mountain to the S. 75° W.; N. 83° W. is a group Kitse-rinak near the Tsangpo; to the N. 67° W. is the mighty gate indicating the valley of the Tsangpo; N. 50° W. is Mount Dünjo; N. 40° W. is the valley of Tsa-chu-tsangpo; on this side of its mouth is an isolated rock, Tsukdor, on the plain; N. 35° W. is the valley of Javö; N. 10° W. Mount Pobrang.

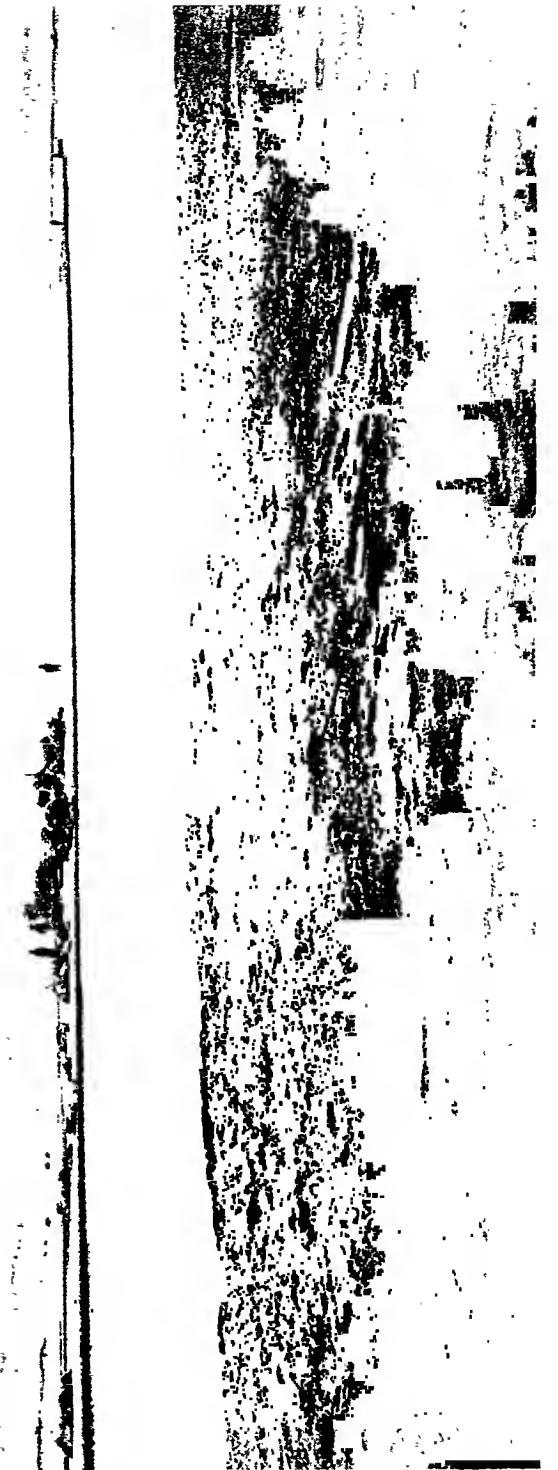
The distance from Tradum S.S.W. to the Tsangpo is 10,3 km. crossing a plain with a fall of only 26m. The road passes several pools between sand-dunes bound by vegetation. Only along the brook which we had first seen at Särchung-la, and which is now called Davak-rong-chu, are there some small hills of schist; the brook is about 25m. wide and very shallow. The place where it is crossed is called Biu; here some dunes are even 8m. high and without vegetation; the steep lee-sides look E.N.E.; accumulation of sand is characteristic to the open plains of the upper Tsangpo valley. Sondongma and Na-karbup are broad tributaries from the east; east of the road are low hills, one of them with a ruined fort on its top.

At the junction of the Tsa-chu-tsangpo and Tsangpo the height is 4,565m. (14,973 feet). Here the joint river sweeps along the foot of the hills which border its valley to the south and consist of graywacke and sandstone. An important road to Nepal crosses the river at this place; Tibetan salt is carried down to Nepal, and a ferry keeps up the communication between the two banks. The ferry place is just below the confluence, where the river is broad and shallow and has a fairly strong current. The Tsangpo is very muddy, the Tsa-chu-tsangpo nearly clear, as had been the case with other great northern tributaries I had seen.

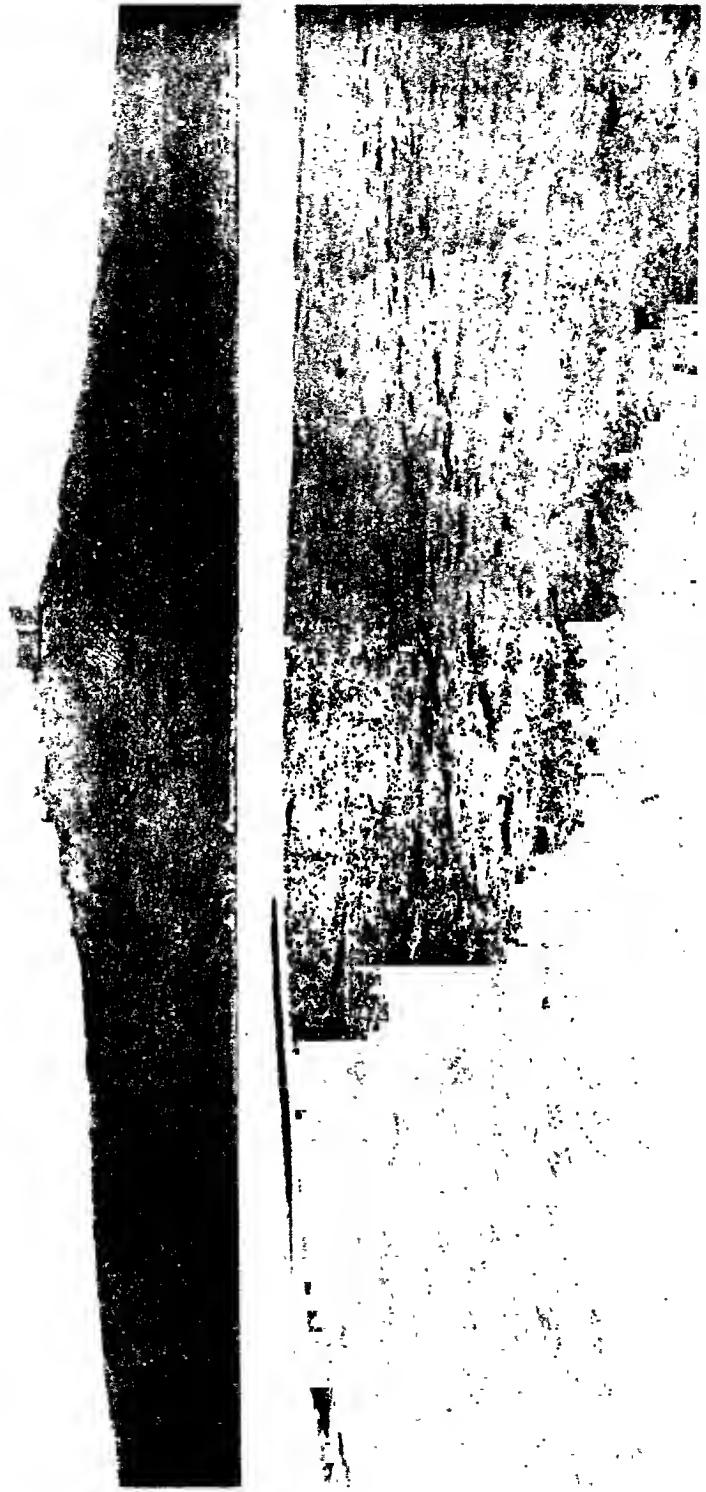
On June 20th the Tsa-chu-tsangpo had the following dimensions: breadth = 32.55m.; maximum depth = 0.96m.; average depth = 0.74m.; average velocity = 0.39m. a second, and volume = 9.44cub.m. a second.

The same day the Tsangpo's dimensions were: breadth = 101m.; maximum depth = 1.75m.; average depth = 1.01m.; average velocity = 0.706m. a second, and volume = 72cub.m. a second.

The Tsangpo thus carried below the confluence 81.5cub.m. a second. Above the Chaktak junction, on May 29th, the Tsangpo carried 71.7cub.m. or 10cub.m. less than at Tradum, on June 20th, in spite of its receiving some tributaries on the way down, amongst others the Men-chu. The difference in volume depends on the difference in time, and 22 days is much during a season when the melting action in the higher regions increases considerably from day to day.



THE FANGS IN THE CONFERENCE WITH THE TRAVELERS FROM



LIKSE-TOMPA ON THE SOUTHERN BANK OF THE TSANGPO

CHAPTER XLVIII.

THE HIMALAYAN WATER-PARTING OF KORE-LA BETWEEN THE TSANGPO AND THE GANGES.

At the S.E. side of the little ridge at the foot of which the Tsangpo flows, is situated the small monastery Liktse-gompa with the plain of Yaken in front of it. From here our road goes S.W. over a little threshold Tsasa-la; several small tributaries enter from the south, Pina-ongma, Pina-parva and Pina-tangbo; the rock is sandstone. The next threshold is Dorap-la at the western foot of which the brook from Kore-la, Chokar-shung makes a sharp bend and falls into the Tsangpo; it carried very little water. The road is much worn and there must be a considerable traffic going on; it consists of some 20 parallel paths, representing the high road to Nepal, and even now several salt caravans were passing. A promontory Ngurkung is of sandstone, two or three isolated rocks near it are called Ngurkung-chang; the valley of Ngurkung-changma leads to the next pass; before reaching it one crosses a right tributary, Ngurkung-shar; a widening of the valley is called Amse.

Ngurkung-la is an insignificant threshold, from the crest of which some of the Lunpo-gangri peaks are seen to the N. 54° E.; at its west side the living rock is schist and sandstone. There the hills come to an end in this direction, and the road turns S.S.W. over level ground; to the right or west extends the broad open valley or plain which stretches north from the Kore-la to the Tsangpo, and the ground of which is very spongy; it is called Nachalak, and many tents and flocks were seen amongst its good grass.

Sara is the name of a tributary valley from the east, and Sara-hla two stone cairns with flags. The next valleys from the east are Lepge-kanchu, Chalung, Shalung, and Nang-tsang, the latter with marked terraces and a brook in three branches. Camp 181 was at a height of 4,595m. (15,072 feet), only 30m. above the Tsangpo at Liktse-gompa. About 20 tents were pitched here.

A very hard S.S.W. wind was blowing the whole day, and increased as we proceeded south. Over the snowy mountains east and west belonging to the northernmost range of the Himalaya dark clouds concealed the summits.

Following as before the eastern side of the valley we continue south to the Kore-la, an extraordinary pass, as it is hardly noticeable to the naked eye; only appro-

aching the water-parting has one the feeling of a pass. The height is 4,661m. (15,288 feet) making a rise of only 96m. from the Tsangpo. On the plain south of Tradum the Tsangpo may therefore indeed be said to stream on a level plateau, from the edge of which the slope goes very steep down to the upper valleys of Nepal. The view to the south is surprising over a wild and deep-cut landscape with its innumerable tributaries from all sides gathering to a principal valley. The rock is conglomerate.¹

The road down follows the steep slopes of a ridge of sandy schist; to our right is a very deep valley Dam, which is soon lost out of sight as we enter another valley, east of and parallel with the Dam, and called Kungchuk-kong; lower down, where the slope gets less deep, it joins the Dam and an eastern tributary, Pama. Dam is the largest of the three and the single one carrying a brook. The rock is lime concretion; the gravel is granite.

The joint valley turns to the S.E. and receives the large western tributary Yamchuk-pu; on its left terrace is the village of Yanichuk, where the first houses and trees are to be seen. In the background of this valley, westwards, there is a confusion of mountains and valleys; the higher regions, however, are hidden by clouds. A part of the main valley is called Neschung, with a solitary house; on the left side terrace is the great monastery of Guru-sambuk; there are fields and irrigation canals and good pasture grounds; the valley may be some 500m. broad. Lower down several other villages follow, as Sekang and Nerbuk. Gurkang-pu is a tributary from the N.E.; in the steep, sometimes perpendicular hill sides are grottoes, obviously used as dwellings; on the top of the hills are ruins of walls and towers. The district was said to be called Tso-shar or Tso-nupa and Tso-sharpa, the western and eastern Tso. Then follow Pinkar and Kamba-karpo, and the valley becomes narrower.

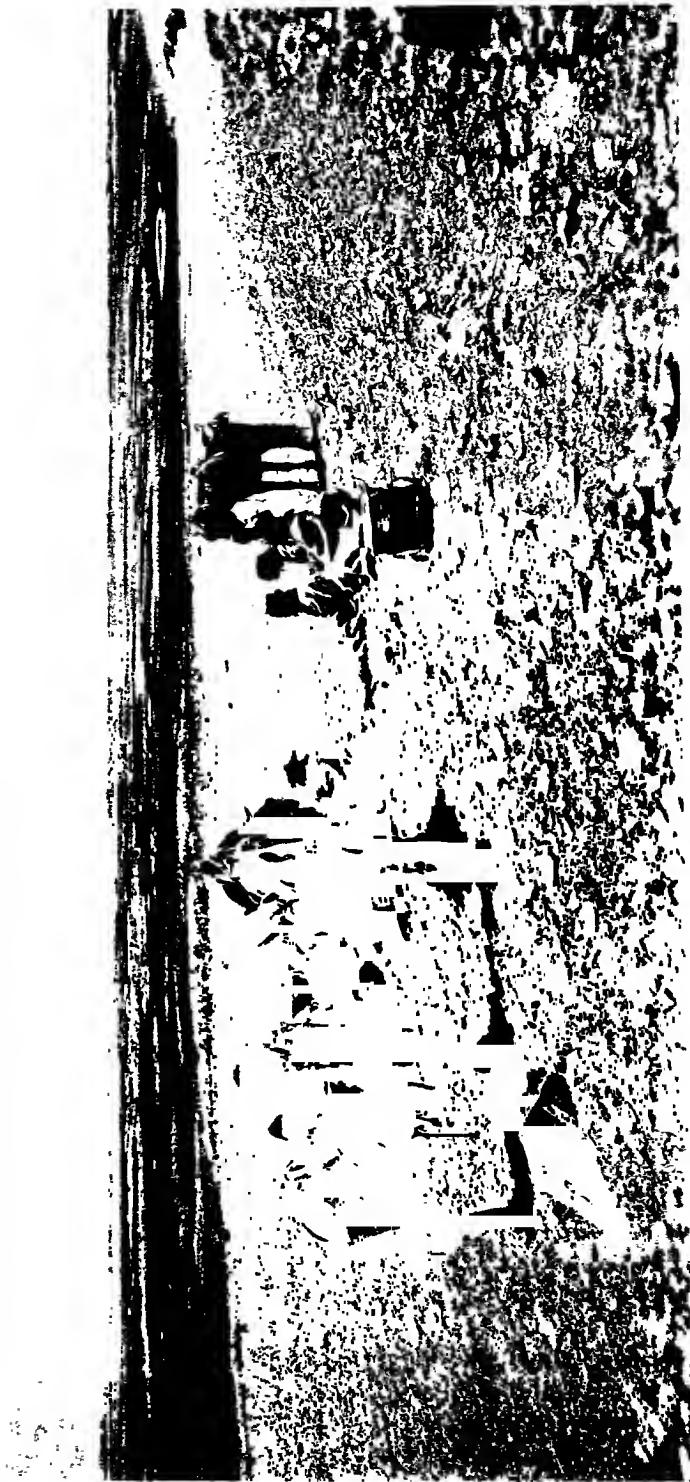
On the left side terrace of the valley is the cottage of Nama-shu in its grove, at 3,806m. (12,484 feet), or 855m. below the Kore-la. A little lower down is a village, Nyanyo with gardens to the left or eastern side; the road follows the right side, either in the bottom of the valley or on the slopes. The brook is one of the feeders of the Kali-gandak. The natives called it simply Tsangpo and Tso-sharki-tsangpo. The residency of the nearest chief to the south was called Mentang, one day hence; it is obviously the same as the Loh Mantang of the map: *India and adjacent Countries, for 1908*; and it is some two days' journey above Muktinath.

From Camp 182 I returned north to the Tsangpo. From Kore-la our old road was left to the right and we travelled to the N.N.W., now with the spongy plain to the east. The ridges and hills north of the water-parting are low and irregular. Several tents were pitched at Choare and Kung-muge, Camp 183, at 4,603m. (15,098 feet).

The next stage to the north crosses excellent ground, with scarce gneiss gravel; to the east are the swampy grazing grounds with tents, flocks and kyangs, to the

¹ The Pundit of 1873 calls the pass Photu-la and gives it a height of 15,080 feet. Compare Pl. XXIV.

ON THE ROAD TO KORF-LA



LOOKING N.N.W. FROM KORE-LA.

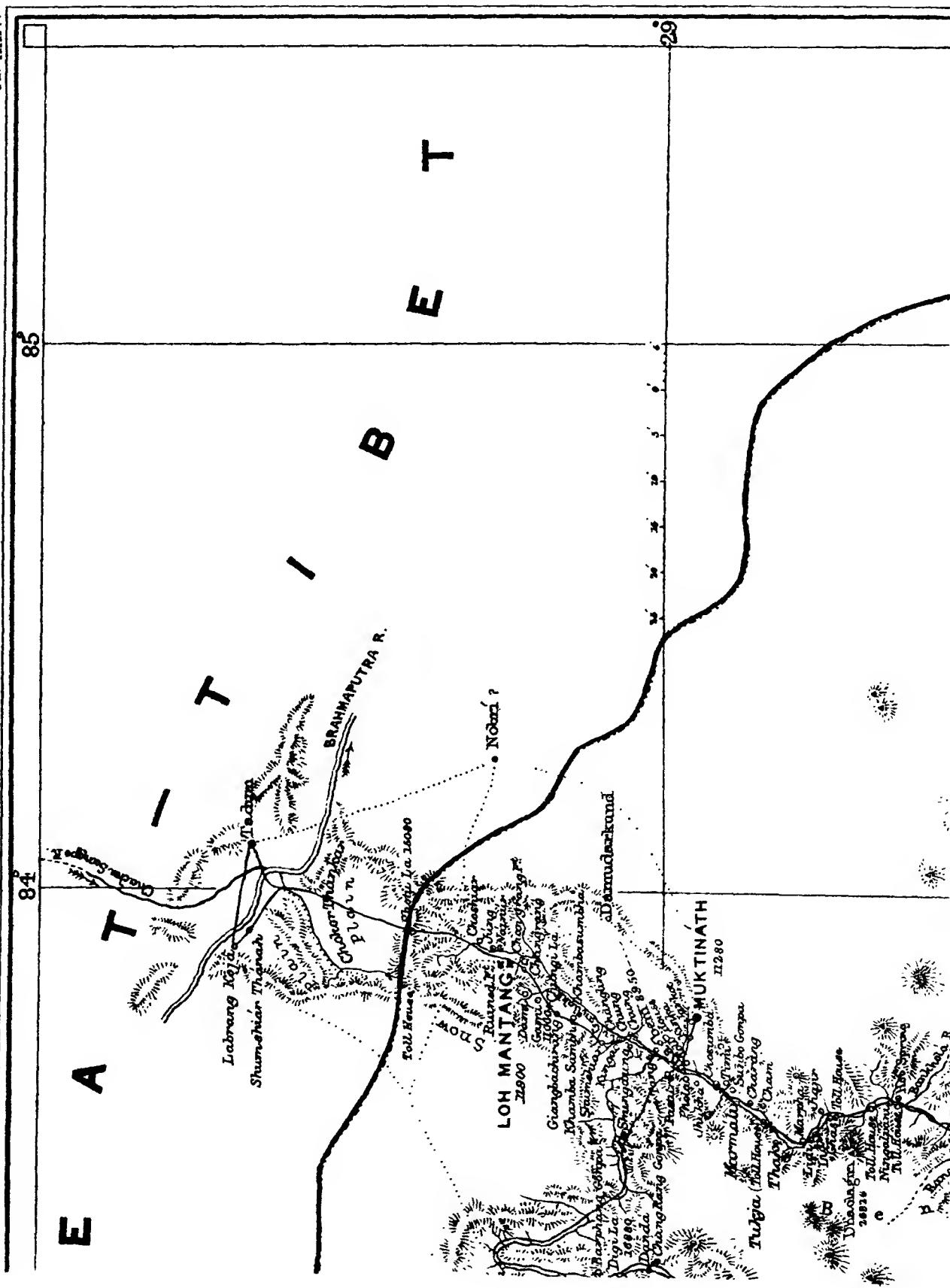


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LOOKING S.S.W. FROM CAMP 182 IN NEPAL.



Journey across Himalaya (Kore-la) by the Pundit of 1873.



west the low hills. The high regions of the mountains were still hidden in clouds, and only one peak could be seen to the west. Many *mani* walls are built along this road, more specially at Sati-keri. A series of small valleys all dry open from the west; only Piju is comparatively large; it has a road over Piju-la to Narung. Entering a little valley with a diabas rock, Chasang, in its middle, and otherwise sandstone at its sides, we ascend slowly to Chasang-la. The gravel is fire-stone and sandstone. On its northern side a valley called Bando goes down. Camp 184, west of a little lake, Tso-tot-karpo, is at a height of 4,594m. (15,068 feet).

Along the foot of the hills the road continues N.W.; to the N.E. is the great plain of the Tsangpo. Shapche is a tributary from the west, the mouth of which we cross; the living rock is glauconitic sandstone and graywacke sandstone. Gakum and Chikum are left tributaries, the first with a brook. To the N.E. is a promontory, Tebo-lugmik. Yakchen-la is a little pass to the east of our road. Higher up in the main valley the rock is breccia and graywacke sandstone. Camp 185 is at 4,796m. (15,731 feet).

The ascent to the pass Tagu-la, 5,026m. (16,485 feet), is steep; the view is much hidden by surrounding mountains. Only parts of the ranges north of the Tsangpo can be seen, as, for instance, some snowy peaks to the N.8°W. Quite near us to the N.32°E. is the group, Kirtse-rinak, and N.55°E. Pompo-nagur; to the N.78°E. a part of the Lunpo-gangri appears over the saddle of Yakchen-la. In the distant S.E. snow-covered mountains raise their heads; three snowy peaks, by the guide called Di, Tanja, and Yara, are seen to the S.28°E. To the S.S.E. are the heights of Gakum-dumboche, S.1°E. is the peak Mubo-gärang, and S.S.W. Chikum. On the pass the rock is graywacke sandstone, and west of it tight quartzitic mass.

West of the pass the road follows the Tambap valley, open and broad. Quite a new panorama now opens up to the west, with a mighty part of the Himalaya called Mogum-gangri. The rock is tight quartzitic mass. From the south enters a tributary Pipu, from the west Ngyunglung. The great plains of the Tsangpo appear again with the meandering river in the middle, looking blue in the distance. The general flatness of the country is surprising, and no high mountains are within sight. Camp 186, Tambap, is at 4,785m. (15,695 feet). The rock is sandstone.

The next march takes us farther down the Tambap valley W.N.W., and out on open desolate ground; the bed of the Tambap is broad and shallow without terraces. North of the road is a series of low hills. From the S.W. enters a great valley Tovö-latsa from Tsen-la with a road to an uninhabited region called Kala.

Our road approaches the hills to the right, consisting of tight quartzitic mass and diabas or basalt; a part of these hills is called Denjung; the specimens of rocks to our left are the same as just mentioned, and limestone.

The road then follows down to the N.W. the valley Närung-tsangpo, containing very little water, most of it in isolated pools in the bed. The valleys Churu and Lungpa-tokpa enter from the left. Takdong is a valley, the mouth of which is seen

to the south with snowy mountains in its background; it is a great valley but has no road. Finally the Närung bed is crossed and in the region Nagor Camp 187 is pitched at 4,608m. (15,114 feet).

The surrounding plain is perfectly flat to the eye. To the N. 35° W. is Tuksum behind low hills; Tabri are some black hills to the north; between them and the yellow mountains that close the northern horizon, is the broad valley of the Tsangpo; to the E.S.E. is again visible the group of Kitse-rinak; Tsenak is a small peak to the S. 53° E.; S. 35° E. is Närung-gangri; the nearest group to the south is Toduk; Tsagdong is a great valley S.S.W.; Ava-talung-tangdip is a snowy mount S. 39° W.; Nindu and Nindu-pu are to the W.S.W., and Utse is a valley beyond. From N. 50° W. to N. 40° W. is the great valley of the Tsangpo, in the far background of which the northern mountains are discernible as a blue haze.

The natives of Nagor asserted that after heavy rains the whole plain north and N.W. of their tract is transformed into a swamp, which takes three months to dry up. At the same time the Tsangpo rises very much and cannot be crossed at all not even by boat, on account of the heaps of sand and mud constantly forming wandering banks in the bed. The two banks are therefore, at this place, completely cut off from every communication during the rainy season. But this year, 1907, as hardly any rain at all had fallen, the river was regarded as exceptionally low, and could easily be crossed even on yaks. At the end of September or in the beginning of October the river gets lower. At Nagor there is said to be a good deal of snow in winter, even up to three feet deep. In spite of the dryness of this year the ground was very spongy on our way to the W.N.W.

The Pung-chu coming from Pung-chu-pu had a brook probably taking its origin from a fine snow-covered group visible to the S. 15° W. On the left bank of Pung-chu is a little sandstone rock, on the top of which the Namla-gompa is built; at its foot is the village of Namla-tungpa. From the height of the hill one sees to the west the valley of Udse with the little lake Ujam-tso, through which the Pung-chu is said to pass. The lake is surrounded by mountains, and seems to be only a few metres above the Tsangpo.

To the N. 33° W. and N. 21° W. are snowy mountains belonging to Transhimalaya. In the same direction the whole plain south of the Tsangpo is full of swamps, which during rainy years become a regular lake. On our road the plain is partly sand and grass, partly alluvial clay obviously inundated during the high water season. Camp 188 on the right bank of the Tsangpo was at a height of 4,590m. (15,055 feet).

THE NAMLA-GOMPA.







THE VILLAGE OF NAMIA ON THE SOUTHERN BANK OF THE TSANGPO, NEAR CAMP 188.



NAMLA-GOMPA

CHAPTER XLIX

THE UPPER TSANGPO TO CHĀROK.

The formation of the bed of the Tsangpo between my Camps 188 and 189 is very curious and irregular. This part of the upper course of the river is very level, open and broad, and more like a plain; the current is therefore slow. Eastwards from this tract the valley gets narrower, the relative height of the mountains more considerable, the river more compact and narrow and the current quicker, until the Tsangpo (and its valley) attains its maxima in all these respects on its way through the Himalaya.

Between the two above-mentioned camps we have first to consider the river itself, and then the lake-like expansions formed by one or several of its tributaries from the north.

The Tsangpo has a breadth of no less than 890m., is very shallow and very slow. The water is full of mud, while in the northern lake-like branches it is clear. The river-bed is mud and sand in which one sinks about 1dm. when crossing the river on foot. Along the banks, specially the northern, the river is so shallow that my boat could not be kept floating. The depth was measured at every 10th metre, at 88 places; the greatest depth was 0.74m., the average depth only 0.34m.; the average velocity 0.26m. a second, and the volume 78.67cub.m. a second.

The measurement was carried out on June 28th. On June 20th the river had carried 72cub.m. at Liktse-gompa. At this distance the river does not seem to receive any tributaries worth mentioning.

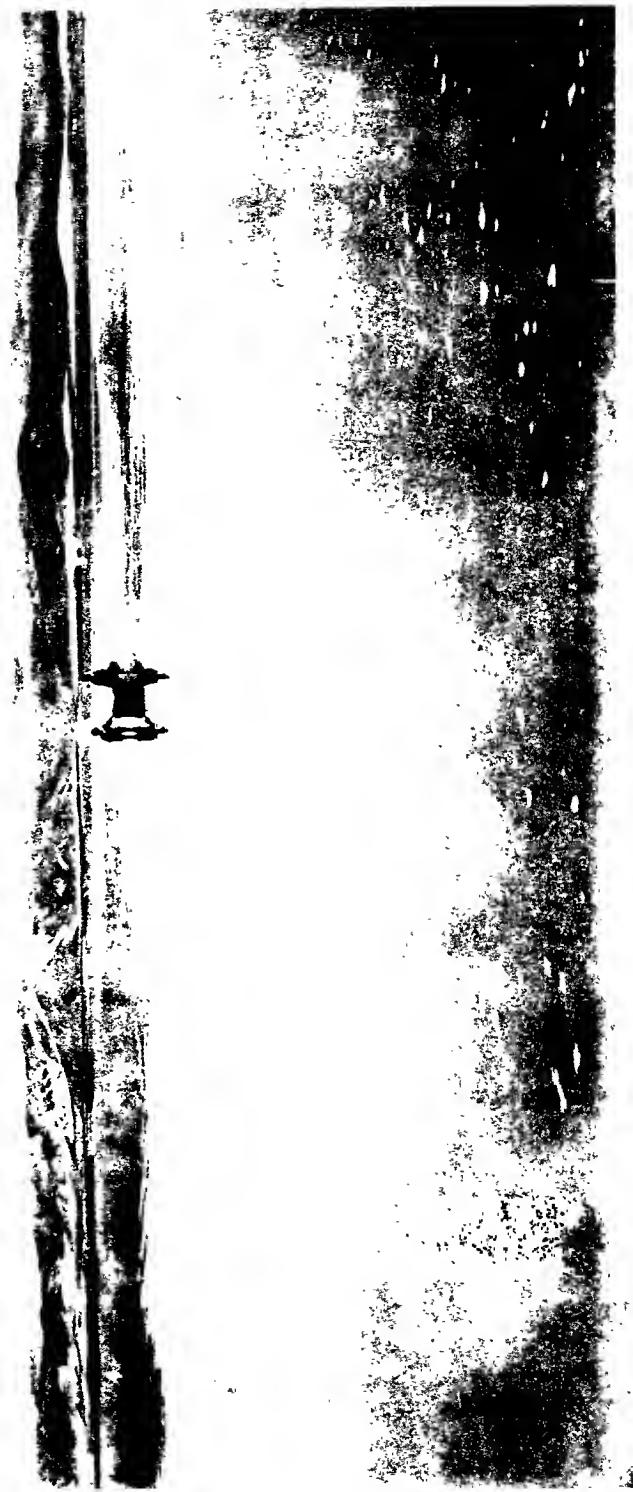
Just below the measured line several branches enter from the labyrinth of lakes which still separated us from Camp 189. This is a most extraordinary confusion of water sheets, currents and sand-dunes. To make reliable measurements under such conditions would have been difficult. All I could do was to make measurements at the narrowest places in the six passages through which a current went to the Tsangpo. Except these the road crosses whole lakes in which no current at all could be observed. The dunes separating them from each other are generally 4m. high, more seldom 8 or 9m. Some of them are partly bound by some

fresh vegetation. Between the dunes the outlines of the water-sheets are extremely irregular, like fingers in all directions. The bottom is always sufficiently hard and very level. At the high-water period these lakes or river expansions get so deep that no passage can be effected; a great many of the dunes are then swept away by the water, and only the greater dunes, on comparatively solid and somewhat higher ground, and bound by grass, are left as small islands. The sand is carried down the valley and forms new dunes further east as soon as the river sinks. At the same time new dunes are formed instead of those which were carried away in the upper reaches. They are temporary formations always appearing again at the same places. The wandering of the sand masses under the action of wind and water is a pulsation of the same kind and as regular as the pulsation of the river itself. To a great extent these dunes are formed by river-sand, but even if no river existed this part of the Tsangpo valley would probably be formed into a sand desert with growing and wandering dunes. As it is the river destroys the dunes and transports the sand, which in its hands is a means of carving out the valley in a quicker tempo. Even the snow in the winter is said not to stop the formation of new dunes, for this snow is as dry as powder and the wind very strong. The valley is said to be so swept by the west-wind that it is difficult to cross on the ice when the drifting sand fills the air and hides the road.

The water in these river-lakes joined the Tsangpo with the following volumes; the first two branches had only 0.417 and 0.05cub.m. a second; the third flowed with the considerable amount of 12.88cub.m.; the fourth with 1.45cub.m.; the fifth with 8.97, and the last with 0.24cub.m., or in all 24cub.m. a second. The result can only be approximate, though no streaming water escaped my attention. Therefore the Tsangpo below the junction carried in all 102cub.m., or 30cub.m. more than at Liktse-gompa 8 days before.

But from where came these 24cub.m. of clear water? In Tuksun I was told that the Tuksun—Shamsang road crosses a northern tributary called Neoo or Näoo-tsangpo, said to be of the same size as the Chaktak-tsangpo. In preceding chapters we have met with this river, which is identical with d'Anvilles's Naouc-Tsangpou. Nain Sing calls it Chu-Nago, »the first large tributary» when coming from the west. Ryder and Rawling do not mention it, but it is drawn on Ryder's map, flowing parallel with the Tsangpo for about 20 miles. Kawaguchi calls it Na-u Tsangbo; he crossed it on October 16th, when all these rivers are falling heavily, but still calls it »a large river flowing from the northern steppes of Tibet and into the Brahmaputra». Though he was shown the best ford the water reached him to the breast, and the current was so rapid that he thought he would be swept away by the river.

Therefore the 24cub.m. of clear water seemed to come with the Näoo-tsangpo. But the problem is not so easy as that, as I was to find two days later when again crossing the Tsangpo.



THE TSANGPO BETWEEN NAMIA AND DONGDZO, CAMP 188 AND CAMP 189.

Camp 189 is called Dongbo; to the N.E., at one or two miles distance is a region called Tutu. Some 10 minutes walk S.80°W. of Camp 189 one has a fine view over the long and shallow lake from which the water spreads to the different passages; in its background was a high sand dune or ridge of several dunes.

Proceeding north-westwards we have to the left for some time a confusion of dunes, lakes and canals, and to our right the hills called Tinju, the last ramifications of the Transhimalaya; at their foot are also considerable accumulations of sand in dunes, often 6 or 8m. high. The ground itself is very sandy, and the wind has modelled out ridges, furrows and sharp terraces of sand, kept together by grass roots. In other respects the ground is fluvialite clay.

Ganju-la is a little threshold crossed by the road, and only 4,618m. high;¹ the rock is sandstone and tight quartzitic mass. A second, still lower threshold is crossed; to our right is a valley Pundi; the plain below is called Pundi-shung. Near the road is a solitary dune, very regularly built, and quite 15m. high; the dunes of this type, and out of reach of the river, are, of course, wandering as ordinary desert dunes. Ganju-gompa is built on a little isolated rock of limestone, rising from the level plain. On nearly all sides it is surrounded by swamps and pools; at some distance south of the monastery one sees the irregular waterways amongst the dunes. On the bank were several tents and flocks.

Kajan-sumdo is a valley from the north. Pukchen-tang is a nomadic camp near a swamp. To the S.W. a branch of the river shows between the dunes, five of which had a very regular form, perfect crescents with 17° slope on the windward and 33 and 34° on the lee-side; 10 and 12m. high dunes are not rare. Even the natives had observed how the dunes wander to the E.N.E., and in fact the lee-side generally looks N.80°E. At Tuksum we are at 4,596m. (15,075 feet).

From the surroundings of Tuksum the following names may be mentioned. S.64°E. Mount Ngotu; S.S.E. Mount Kolla; S.7°E. a snowy peak Inang, near which a road goes to Nepal over Inang-la; S.17°W. Gānsung a double peak without snow; S.39°W. Pajung-hangmo a sharp snowy peak, and S.60°W. another, near which there is a difficult path to Nepal; S.65°W. Mount Rongle; S.68°W. a small mountain Langjü; N.71°W. the depression of the Tsangpo valley; N.54°W. Tang-yung and just right of it the valley of Näoo-tsangpo; N.30°W. the valley of Tsagong-sang, and, to the left of it, Mount Mondo; to the north is Mount Teriyong near Tuksum; N.E. the valley Dogmo-sang, and N.69°E. Mount Rinak.

Keeping south of the *tasam* our next day's march goes west to the Tsangpo over the great level plain with its beds, dry or containing pools, its tents and

¹ Or 15,147 feet. There seem to be several passages over the ramification in which my Ganju-la is situated; for Ryder's Ganju-la is 15,700 feet high and is at 3 miles from the river, whereas mine is hardly one mile from it. My Ganju-la is not even 30m. above the river, Ryder's 210m. Ryder's road is here some short distance north of mine. For Tuksum Ryder has 15,000 feet, I 15,075; for Tradum Ryder 14,840, I 15,060; for Shigatse Ryder 12,850, I 12,700 feet.

nomads, and its small dunes bound by vegetation. From Camp 191, 4,608m. (15,114 feet) high, one sees to the north, through the opening of Tsagong-sang, a range with some strips of snow.

The left bank is perpendicular and nearly 2m. above the river; its soft sand and clay is constantly eaten and eroded by the current, so that blocks of earth are often heard falling into the water. The water is grey and muddy, the current slow.

This is only one branch of the Tsangpo, and just below the Camp it is split up into several smaller branches. The river is irregular, and undecided, and on the almost horizontal plain the waterways are meandering in all directions.

The first and principal branch was divided by a long narrow sandbank into two parts, of which the eastern one had the following dimensions: breadth = 50m.; maximum depth = 1.62m.; average depth = 1.306m.; average velocity = 0.735m. a second, and volume = 48cub.m. a second. The western: breadth = 30.2m.; maximum depth = 0.96m.; average depth = 0.466m.; average velocity = 0.582m. a second, and volume = 8.19cub.m. a second. That is to say 56.19cub.m. in all, July 2nd. A little below the place the river could be forded with yaks.

On July 3rd we continued S.W. and soon came to a little branch with only 0.32cub.m. The next branch was considerable and had the following dimensions: breadth = 59.8m.; maximum depth = 0.85m.; average depth = 0.582m.; average velocity = 0.392m. a second, and volume = 13.64cub.m. a second.

Further on in the same direction the plain becomes a little undulating; here a branch of only 0.10cub.m. is passed. The next branch is great and muddy: breadth = 36.45m.; maximum depth = 1.26m.; average depth = 0.873m.; average velocity = 0.703m. a second, and volume = 22.37cub.m. a second.

The five branches, great and small together, therefore carried 92.6cub.m. a second.

If now the branches with clear water coming from the lake-like expansions near Dongbo had really contained water from the Näoo-tsangpo, I should have crossed this northern tributary on my way from Tuksum to Camp 191. In fact no tributary at all was crossed on this road. Ryder's map shows the confluence of the Näoo-tsangpo straight south of Tuksum, and Nain Sing's map shows it S.W. of Tuksum. Both must be wrong for my Camp 191 lies due west of Tuksum on the bank of the Tsangpo and I had not crossed the great tributary. Therefore the junction of the Näoo-tsangpo with the Tsangpo must be situated above Camp 191.

The first branch, with 56cub.m., includes the Näoo-tsangpo. Just below Camp 191 this branch divides into several branches. The greatest part of the 56cub.m. joins the Tsangpo; the rest forms the lake-like and very shallow expansions amongst the dunes, where the muddy water almost immediately becomes clear.

Continuing S.W. we pass between dunes partly bound by vegetation. Here is a little lake, Gävä-tso, surrounded by dunes, and full of small islands and wild geese. It is formed by the Gyang-chu or Kyang-chu, at the right bank of which

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THE TSANGPO AT CAMP 191.

'THE TSANGPO AT CAMP 191'



we have Camp 192. The name of this place, where a few tents were pitched, is Yüri; a valley coming down from the S.W. is Tugerong; Langchu is an isolated hill to the west of the place; the snowy mountains to the south were called Shita and Shise.

At 7 o'clock the following morning, July 4th, the Gyang-chu was measured: breadth = 36.5m.; maximum depth = 0.40m.; average depth = 0.20m.; average velocity = 0.22m. a second, and volume = 1.6cub.m. a second. Two days later, in the afternoon, the same tributary was crossed higher up at a place where it was divided into several shallow branches difficult to measure, and carrying about 5cub.m. a second.

Farther west our road leaves to the north the hills of Tagbun-chagma, and to the south the two small hills of Tagbun-loma; in the former is a valley Tagok-tsang through which the Gyang-chu flows. Tagbun-chopta is the region round some pools a little further west. The whole day's march we have hills to the north, which may be regarded as the last and northernmost ramifications from this part of the Himalaya. The rock is red quartz and tight quartzitic mass, — in a hill called Ara-torjung. On the other, or northern side of the road is the hill Ara-martsuk, and beyond it Chung-tsang; further on we leave, to the south, Ara-tanya. Having left these detached hills behind us, only an open plain separates us from the foot of the southern mountains, to which it may be some 5 or 6 miles distant; Muri and Murisangbuk are two hills near the Tugerung-brook, a tributary from the south to the Gyang-chu.

The plain is partly covered with grass, partly with gravel, and sometimes there are small naked dunes, specially where the Gyang-chu bends its course amongst the small hills. Ärki-chu is a tributary from the S.W., carrying some water. At the southern foot of the Churi hills the Gyang-chu is seen joining Tugerung and Ärki-chu.

Camp 193, Nangi, is at 4,627m. (15,176 feet), at the very foot of the Himalaya. There are many tents with great flocks of sheep, goats and yaks. To the N. 30° W. is Nupkir a small isolated rock, to the north a small Mount Samchuk-tebo; N. 23° E. a rock Kyambung-dsong with ruins; Sabo-suksar is a valley to the N. 30° E.; N. 58° E. is a dominating peak Shär-konka near Churi; Ngonur is a hill to the N. 75° E.; Golung-kaleb a valley S. 64° E.; Sagelung-kaleb a valley S. 15° E.; and Gobuk a valley S. 25° W.

Leaving Nupkir to our left we proceed northwards over the spongy or gravelly plain. As the distance increases from the southern mountains the snowy peaks again become more and more visible, though much is still hidden by the rolling brownish hills at their foot. At Gyang-chu-kamar the height is 4,661m. (15,288 feet). Here the Gyang-chu has a strong current and forms small rapids. Five tents were pitched at the place.

To the S. 5° E. is the sharp snowy peak we had seen before; near it is said to be a pass, Kung-la, with a road of 8 days to Tovo in Nepal; S. 24° W. is a peak

Kakyu; S. 30° W. is the valley Tsagelung-kaleb; to the S. 49° W. is Teboche a valley and a mountain; to the S. 57° W. is a sand-covered hill situated in the broad valley Rongle with a road over Nangsa-la to Mogum in Nepal; S. 75° W. is the valley Changma-lung; the near mountains to the N.W. are called Nendo or Mendo with a valley Mendo-bup.

The next day's march takes us N.W. The Gyang-chu and its right tributary Rong-kardum-chu soon disappear to the south. At the mouth of the northern tributary Rubi-naya the rock is plagioclas-amphibolite, granite and limestone-like mass. Rubi-la is a little threshold on the road, 4,675m. (15,334 feet), from where is seen to the S. 38° W. a black promontory, just east of which the Gyang-chu is said to come out on the plain from its mountain passage. To the N.E. we see the Transhimalaya valley Hlalung with a road to the Tabie-tsaka of Chang-tang.

Sabsang-chu is a considerable tributary from the valley Kogung to the west; its bed is very broad and bounded by 6 or 7m. high erosion terraces, the right one in three stories; the brook was divided into three branches carrying 3.5cub.m. together; but great parts of the bed were still moist proving that only a few hours ago a much greater amount of water had come down from the northern slopes of the Himalaya. If such pulsations in the tributaries of the upper Tsangpo take place simultaneously, they must of course give rise to considerable oscillations in the main river as well.

The last bit of the road goes over the flat gravelly scree from the foot of the western mountains. At some distance to our right is the sharp limit between the brownish red scree and the green plain which follows the right bank of the Tsangpo. Going down the 6 or 7m. high terrace of the Tsangpo we camp at the bank of the river near Chärok, at a height of 4,657m. (15,275 feet).

CHAPTER L.

RECAPITULATION OF THE VOLUME IN THE TSANGPO.

As shown above I measured the Tsangpo at seven different places. The season was very favourable in April, May, June and the beginning of July, and as there was hardly any rain at all during the summer of 1907, no irregularities occurred in the catchment area, and the volume of the river almost only depended on the increasing melting of ice and snow. Of course rain may have fallen in the higher regions, which was impossible to observe from my road.

I found the Tsangpo to contain the following amounts of water, in cubic metres: April 6th = 105, May 29th = 91, June 20th = 82, June 28th = 103, July 3rd = 93, July 6th = 44, and July 8th = 34. The volume therefore generally decreases from east to west, in spite of the progress of spring and summer. The tributaries are of course responsible for these relations. From June 20th to June 28th there is a great irregularity, but from June 28th again there is a regular diminution of the volume.

But if we consider the river at different sections of its course, and pay special attention to the greatest tributaries, we clearly become aware of the great influence of the advancing season. At the confluence with the Dok-chu the Tsangpo alone had, on April 6th, 75cub.m., which includes not only the joint Tsangpo and Chaktak-tsangpo with their 91cub.m., on May 29th, but also all the small tributaries on the section from Chaktak-tsangpo to Dok-chu. Here only the advancing season could account for the fact that the 91cub.m. at the Chaktak-junction became 75cub.m. at the Dok-chu junction. Had measurements at both places been carried out the same day, the result would have been quite different.

At the Chaktak junction the Tsangpo alone had 72cub.m., on May 29th though the joint river, on June 20th, carried 82cub.m. at the Tsa-chu-tsangpo junction, and in spite of other tributaries entering the Tsangpo on the section between the Tsa-chu junction to the Chaktak junction.

The 103cub.m. at Dongbo, on June 28th, become only 72cub.m. just above the Tsa-chu junction. Here some new factor seems to enter, disturbing the regularity. There are no tributaries worth mentioning between Tsa-chu junction and Dongbo but still the river could hardly lose so much as 31cub.m. on so short a distance. But below Dongbo and south of So-la Ryder's map shows a lake-like expansion of the river, where the evaporation surface must be very great, and where probably

just in June, when the river rises energetically, the first fresh inundations of the plain to a great extent get absorbed and lost in the sand-dunes.

It is more difficult to understand why the 103cub.m. at Dongbo, on June 28th, could be the result of the 93cub.m. of the Tsangpo, July 3rd, between Camps 191 and 192. The Gyang-chu with its 3 or 4cub.m. does not much change the problem. The strong decrease must partly depend on the weather, perhaps clouds without precipitation in the source regions, and partly on the hour of the day, for the nearer one approaches the sources, the more the pulsations between day and night must become noticeable. And finally south and S.W. of Tuksun the Tsangpo receives two great tributaries from the Himalaya, as shown on Ryder's map; they probably bring down a considerable addition to the volume at Dongbo.

From the same causes, weather, hour of the measurement, and tributaries, of which one or two from the north may be considerable, and one from the south, Sabsang-chu, carried 3.5cub.m., depends the fact, that the joint Tsangpo at Chärok carried only 44cub.m. a second. Perhaps another factor enters at this advanced season, namely a diminution in the volume caused by the melting of the snow; for in the beginning of July a great amount of the winter-snow filling the valleys and slopes has already disappeared, and if no fresh precipitation falls, the river therefore sinks. When the great masses of fresh snow have melted away in early summer the river will probably, if no new precipitation falls, remain fairly stationary during the rest of the summer. But it may be regarded as pretty certain that a good deal of rain and snow falls in the high regions, specially on the Himalaya, even if the weather remains clear in the Tsangpo valley and in the Chang-tang, and that the river therefore, even during such a dry summer as 1907, increases slowly till August, when it reaches a maximum, which may be nearly constant perhaps for weeks. Later on the river falls, slowly at first and then quicker.

Finally we found, on July 8th, that the Tsangpo alone, now called Kubi-tsangpo, carried 34cub.m. or a little more than the Dok-chu on April 6th, which then had 30cub.m. At the point where the Kubi joins the Absi and Ngoma-dingding brooks I estimated the volume at some 25cub.m., of which only 15 remain for the principal glacier source of the Brahmaputra.

In 1907 the Tsangpo was exceptionally low. From descriptions I got from the natives it is obvious that the river must ordinarily be much larger. If 1907 had been a rainy year I should probably not have been able to make any measurements at all with the means I had at my disposal.

I heard the following names for the river: Yere- or Yaru-tsangpo, Tsangpo-chimbo, Sangchen, Damchok-tsangpo, Damchok-kamba, Damchu-kamba, Martsang-tsangpo, and Kubi-tsangpo, which is used for the section from Shamsang to the very source. But very often the Tibetans call the river simply Tsangpo, or *The River par préférence*, and indeed the Tsangpo is the great artery in the country of the Lamas.

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